SPECKLES @ NCD

NCD source characterization

```python
def getUndK(gap_um):
    min_valid_K=0.5
    a_0=-178.683137165;a_1=101031.437305031;a_2=-268554.955894147
    a_3=333043.58574148;a_4=-223412.253880588;a_5=78201.083309632
    a_6=-11222.656555176
    r=np.roots(np.flipud([a_0-gap_um,a_1,a_2,a_3,a_4,a_5,a_6]))
    r=r[np.isreal(r)];r=r[r>=min_valid_K]
    return r.real[0]
ALBA_Energy=2.98
ALBA_gamma=1+ALBA_Energy*1e3/0.511
harm=11
Gap_um=6.05e3
ALBA_und_Period=0.0216
ALBA_und_numPer=92
ALBA_und_K=getUndK(Gap_um)
ALBA_und_B= ALBA_und_K/(0.934*ALBA_und_Period*1e2)
ALBA_und_LambdaPeak_nm=(1+ALBA_und_K**2/2)/(2*ALBA_gamma**2)*ALBA_und_Period*1e9
wl_nm= ALBA_und_LambdaPeak_nm/harm    # on peak und radiatition
```

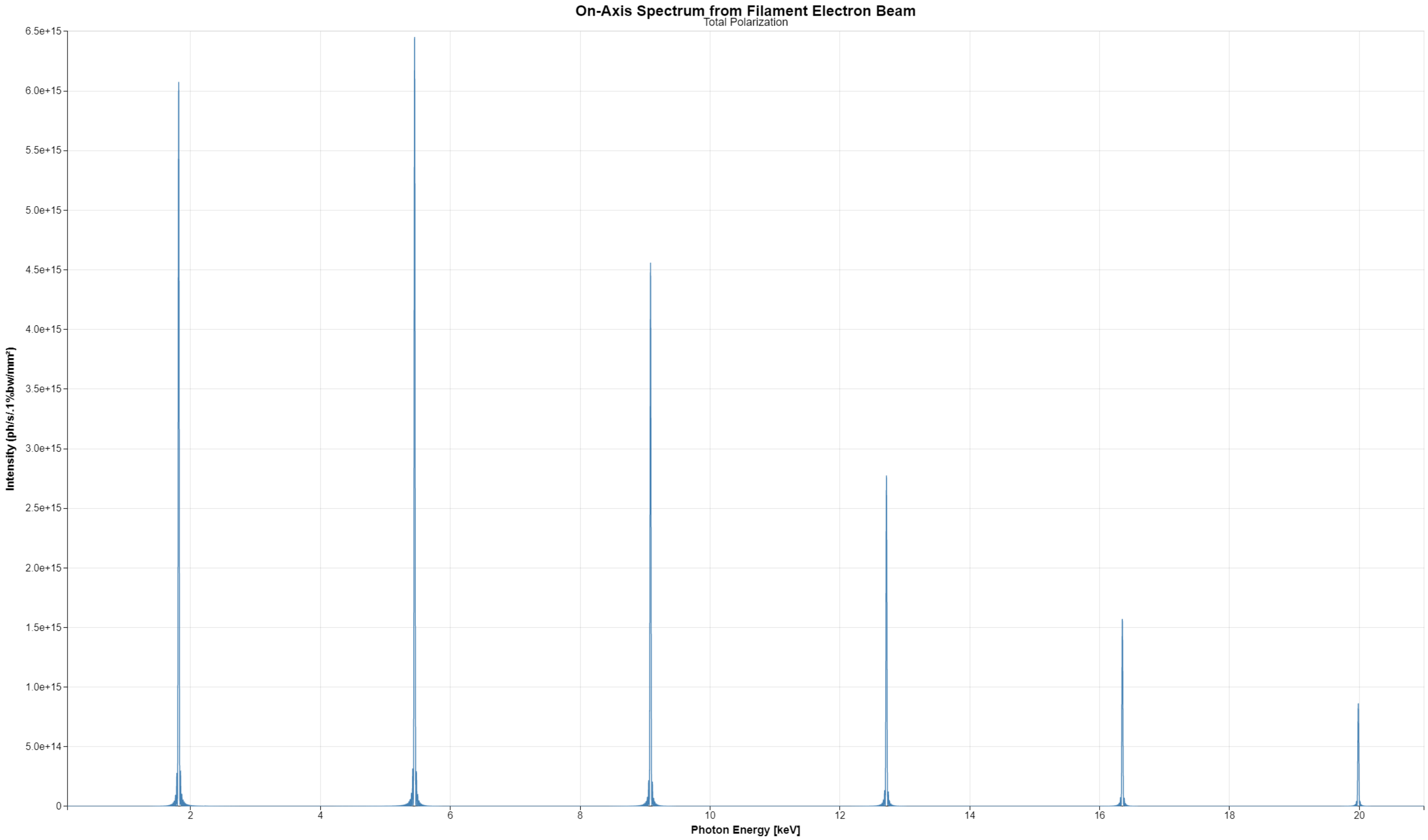
Misalignment

$$g = \sum_{i=1}^{6} a_i K^i + 31.25$$

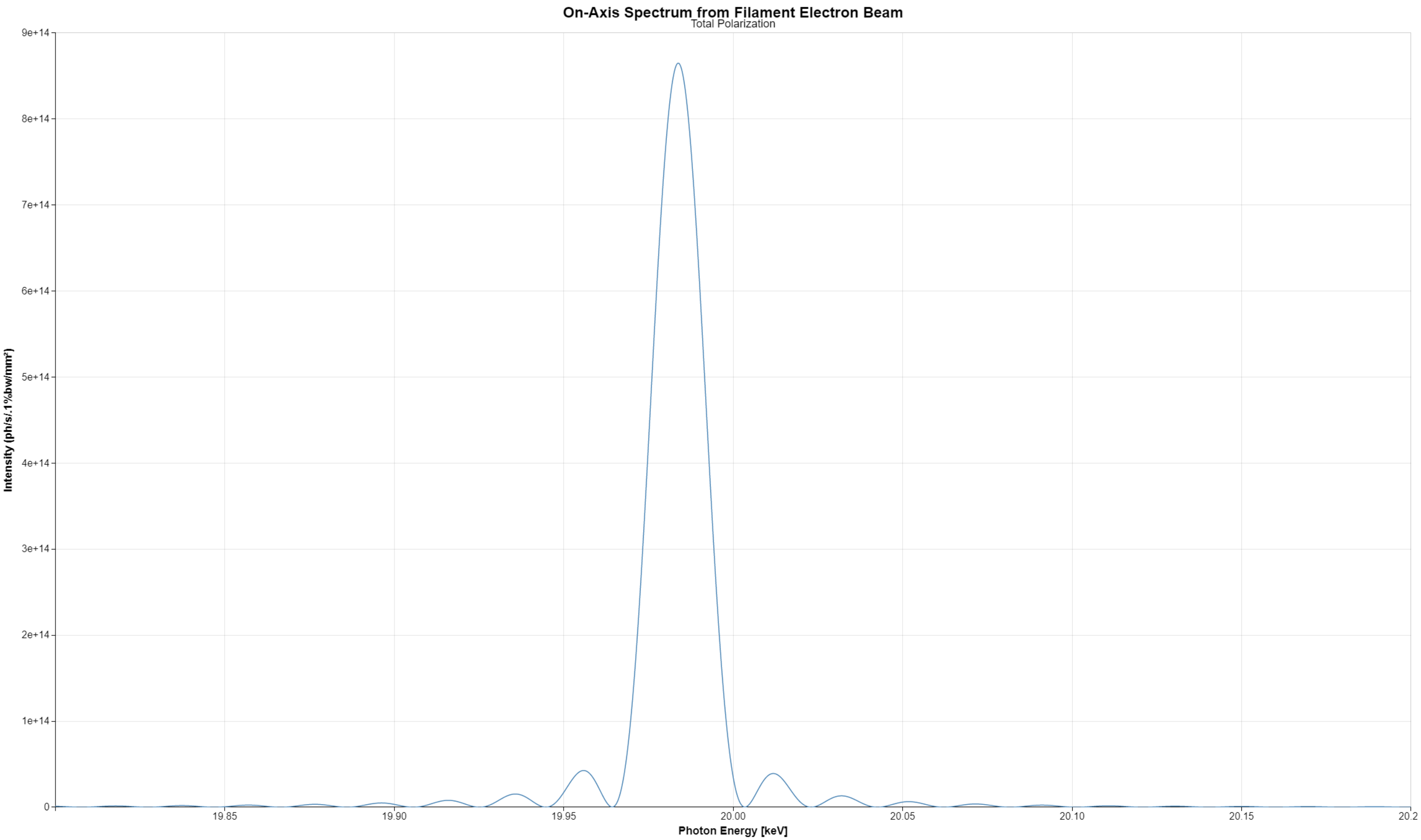
a_0	-178.683137165
a_1	101031.437305031
a_2	-268554.955894147
a_3	333043.58574148
a_4	-223412.253880588
a_5	78201.083309632
a_6	-11222.656555176

New model

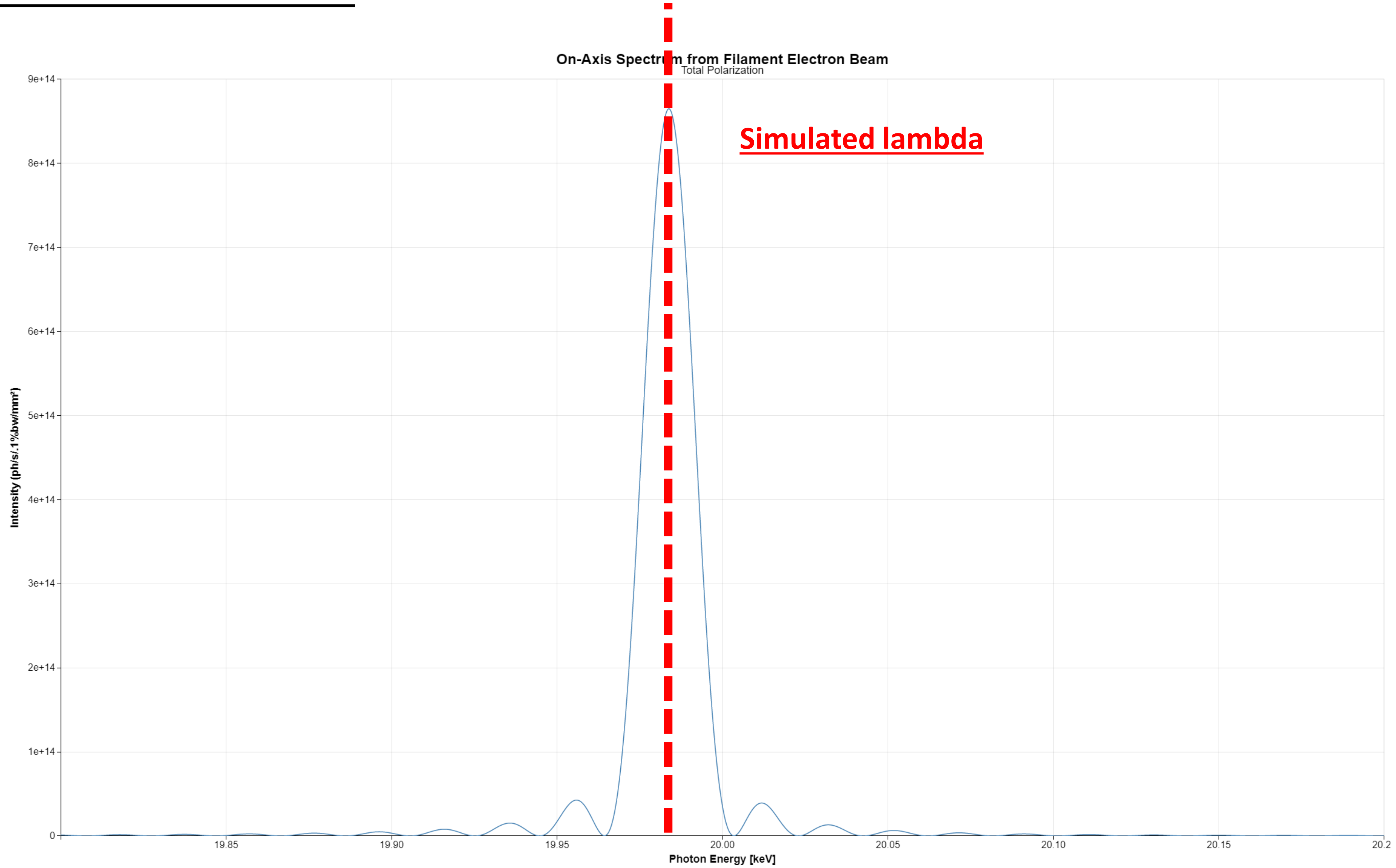
NCD source characterization



NCD source characterization

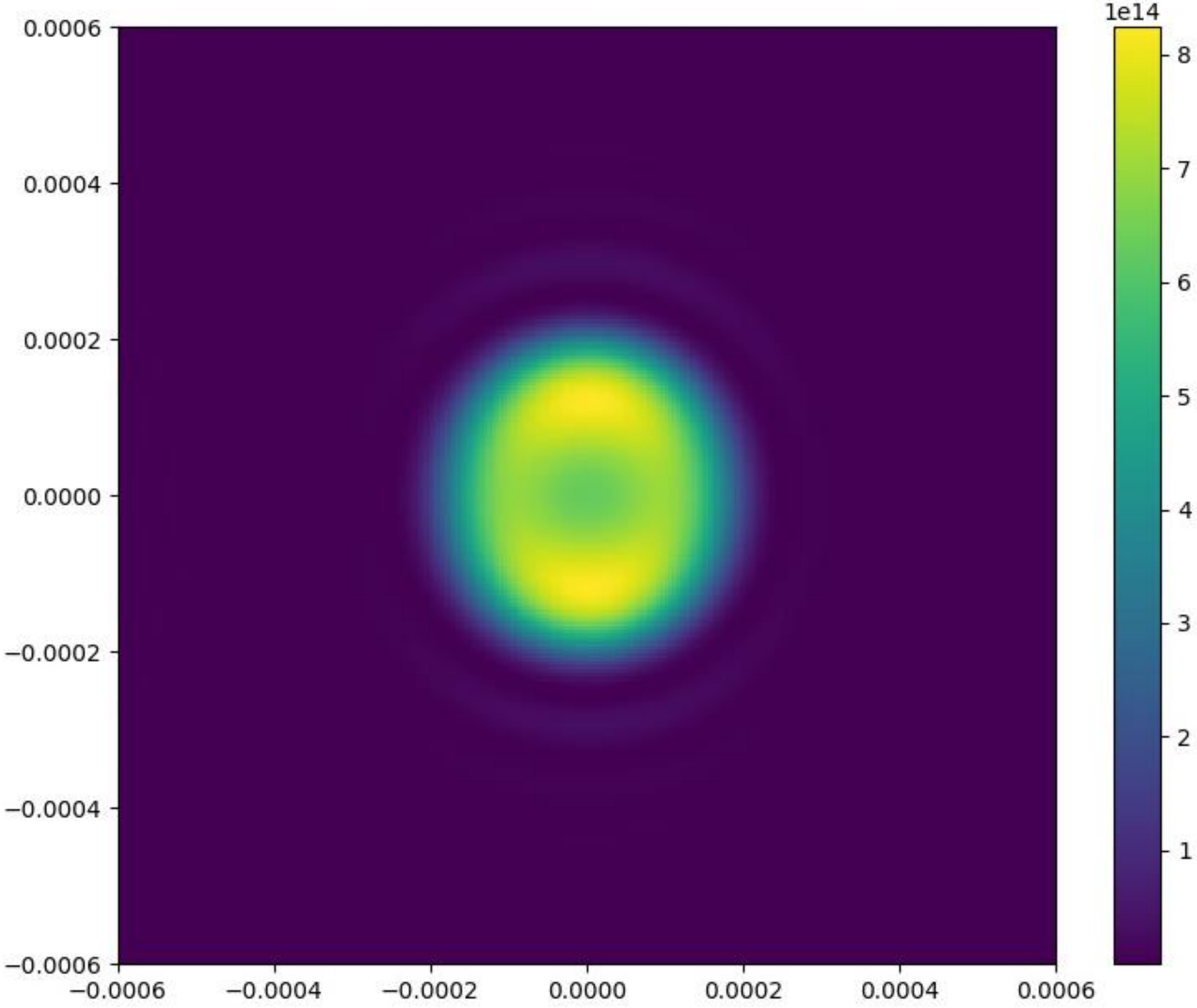


NCD source characterization

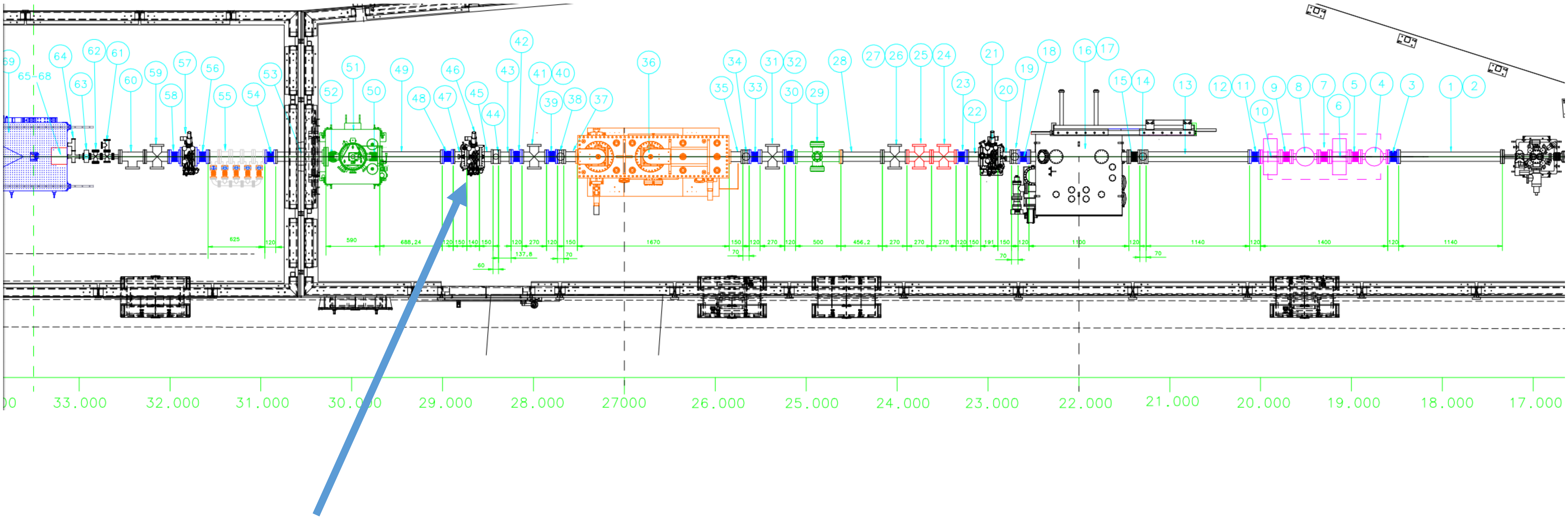


NCD source characterization

Light distribution from
a single particle
@
(X,Xp,Y,Yp)=(0,0,0,0)



Beam divergence and Slits

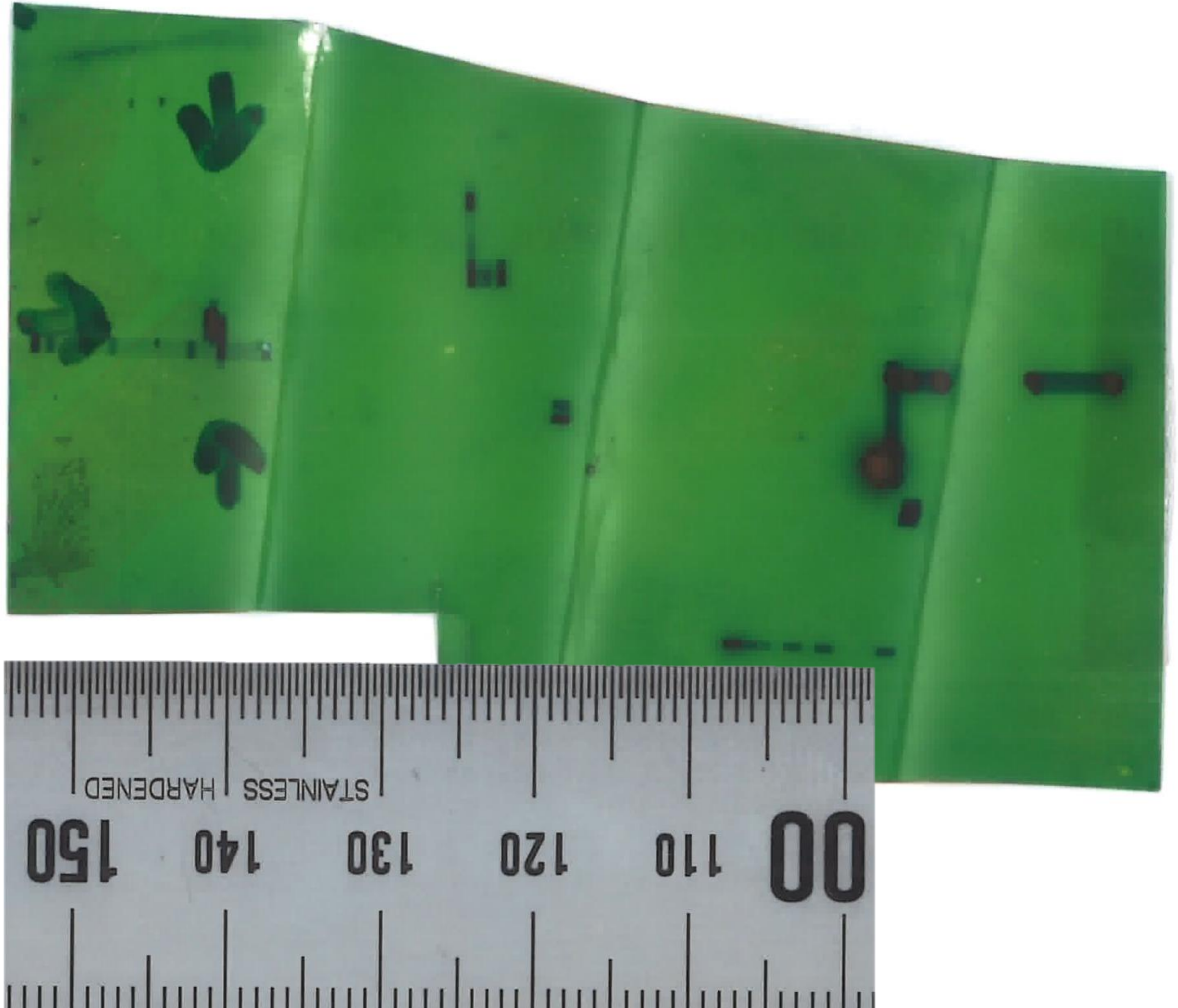


JJ X-RAY slit
Closed to 1mm x 1mm ?

ALBA BEAM (nominal k)

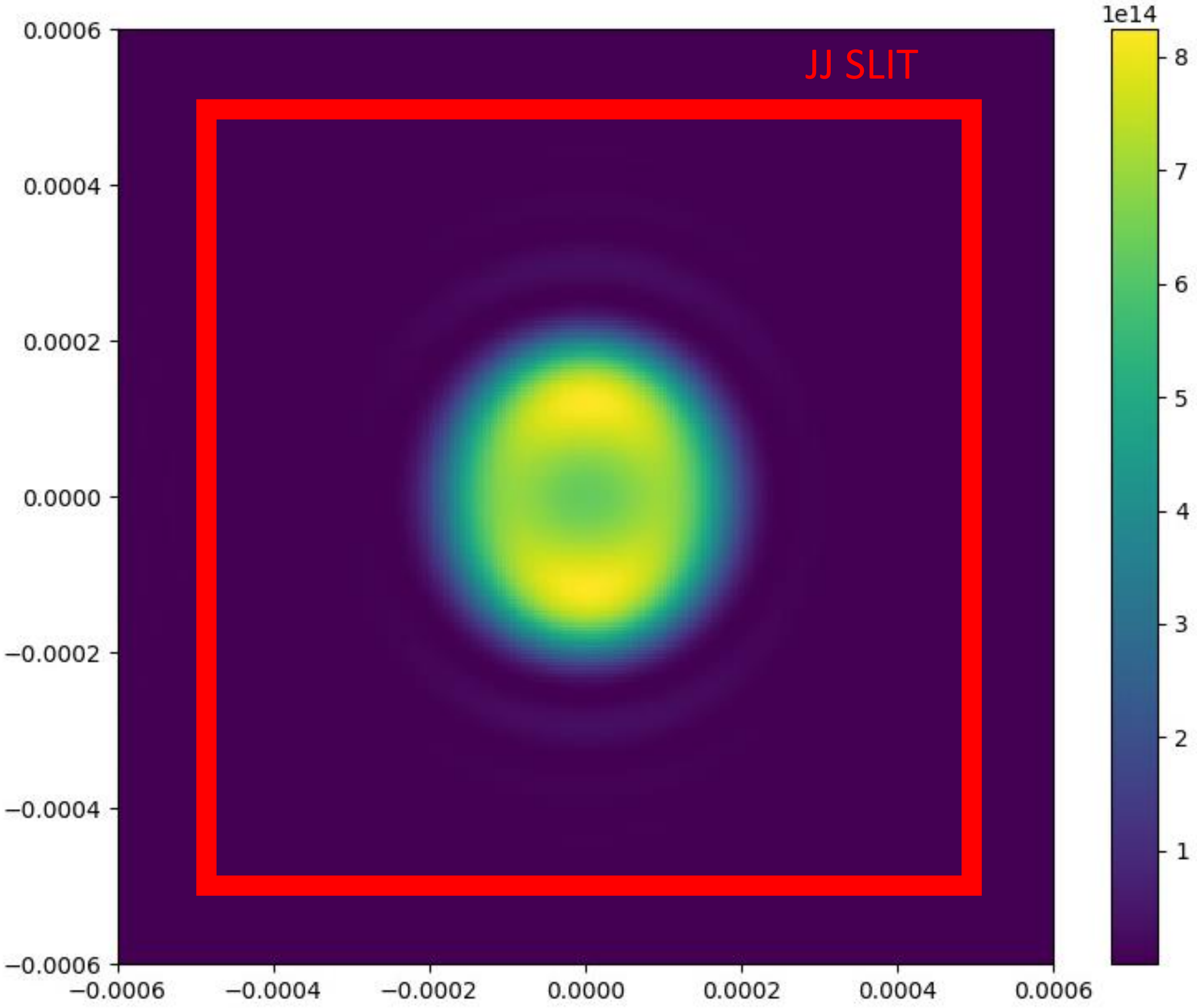
sigX = 130e-6
sigXp = 46e-6
sigY = 5e-6
sigYp = 4e-6

Simulated 800 particles
(estimated output 1 TB)



NCD source characterization

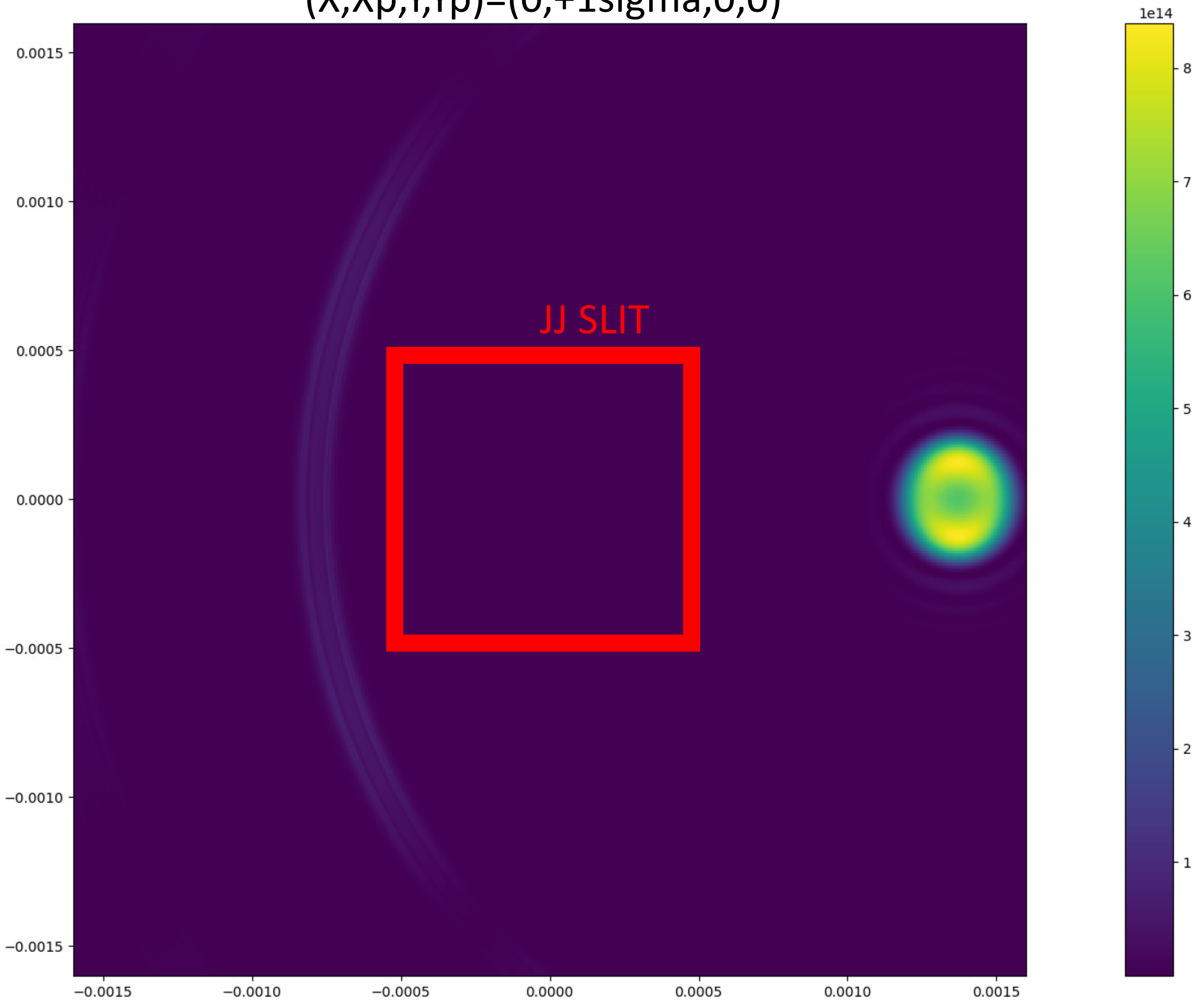
Light distribution from a single particle @ (X,Xp,Y,Yp)=(0,0,0,0)



ALBA BEAM (nominal k)

sigX = 130e-6
sigXp = 46e-6
sigY = 5e-6
sigYp = 4e-6

Light distribution from a single particle
@
(X,Xp,Y,Yp)=(0,+1sigma,0,0)

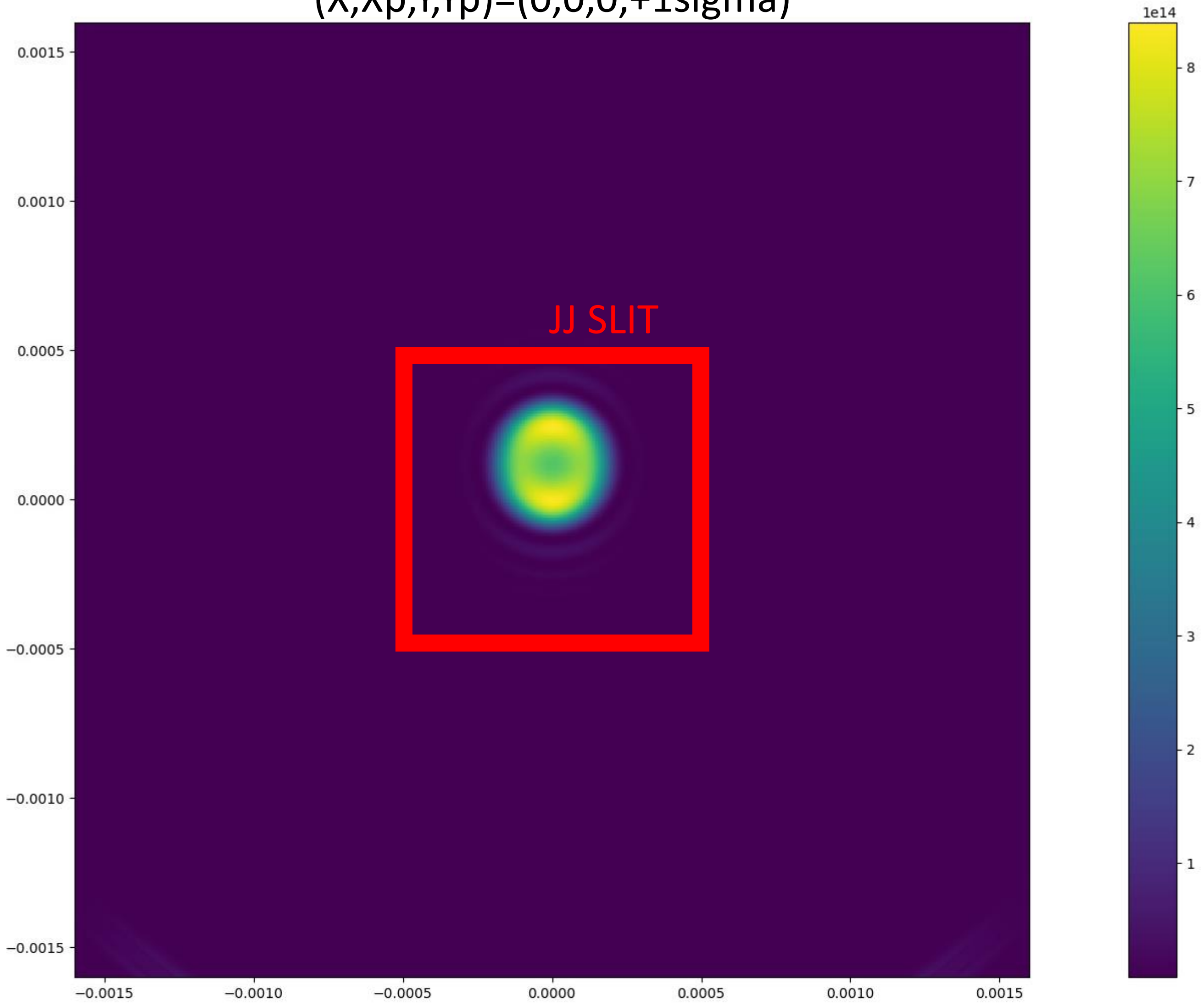


Particle at 1sigma in H divergence!

ALBA BEAM (nominal k)

Light distribution from a single particle
@
(X,Xp,Y,Yp)=(0,0,0,+1sigma)

sigX = 130e-6
sigXp = 46e-6
sigY = 5e-6
sigYp = 4e-6

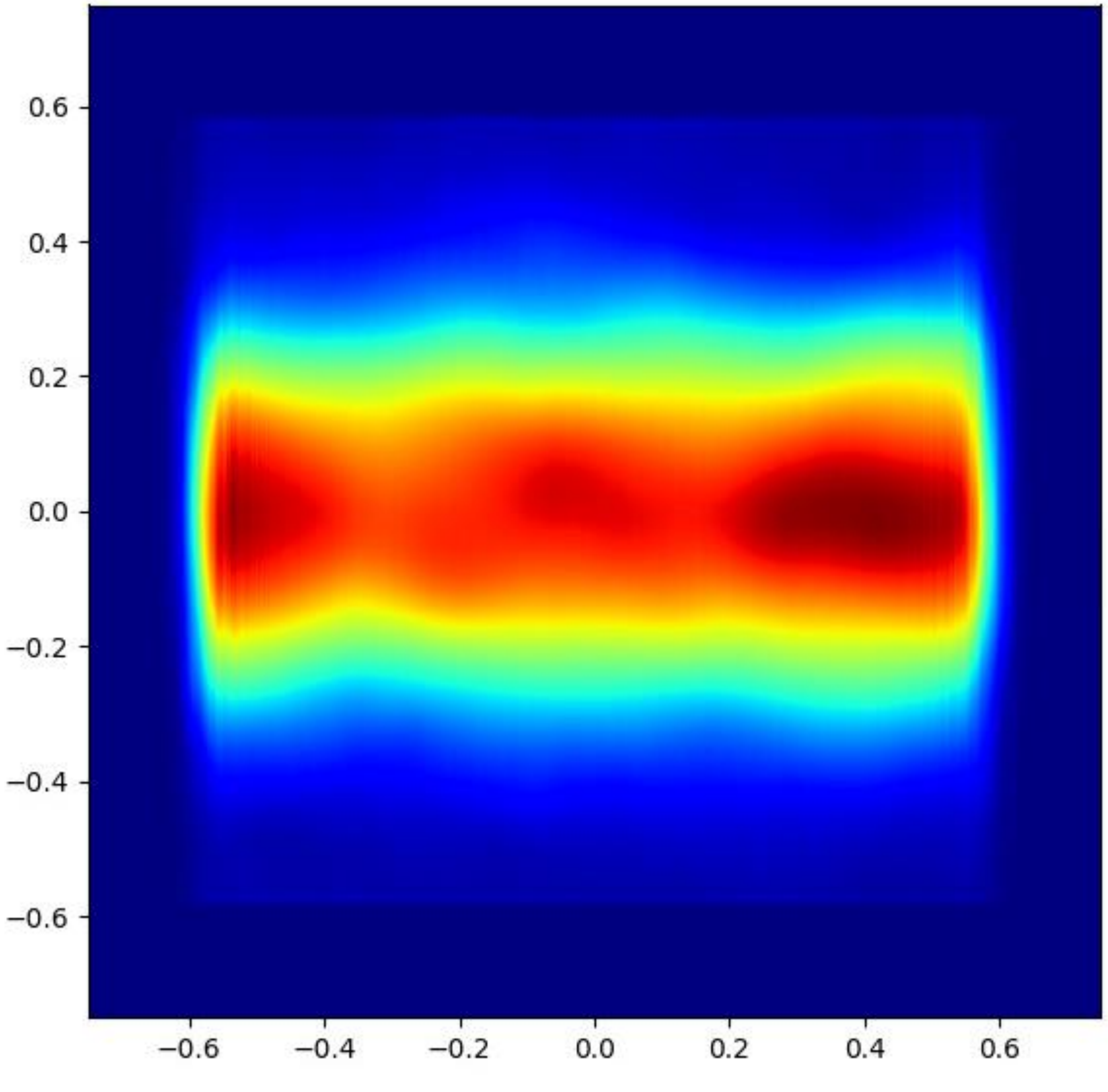


Particle at 1sigma in V divergence!

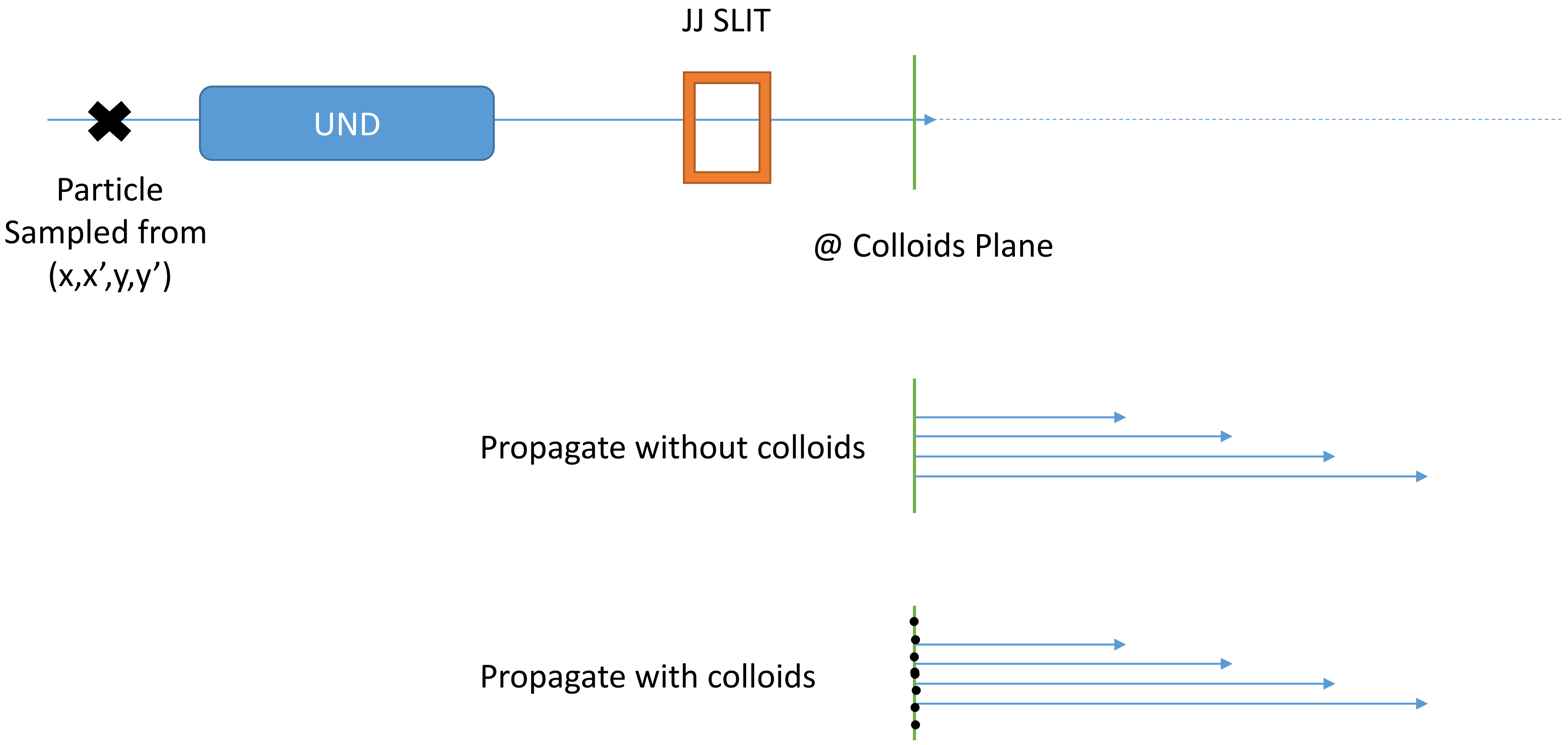
ALBA BEAM (nominal k)

sigX = 130e-6
sigXp = 46e-6
sigY = 5e-6
sigYp = 4e-6

Simulated 1500 particles
On the colloids plane



Simulation

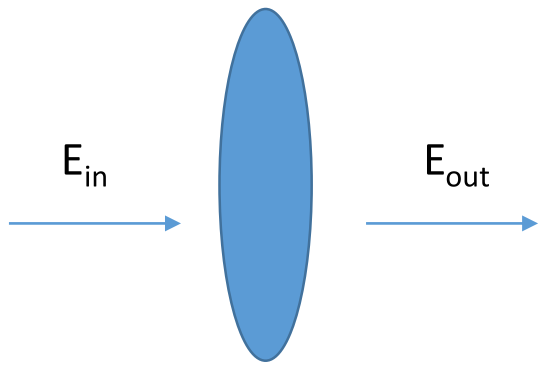

JJ SLIT
UND
Particle
Sampled from
(x,x',y,y')
@ Colloids Plane
Propagate without colloids
Propagate with colloids

Colloids

sensorSize=4e-3 #m
MAG=23
holder_thickness=1e-3 #m
Rcoll=250e-9 #m
Concentration=0.15 #W/W
ro_coll=2650 #kg/m3
ro_water=1000 #kg/m3

Ncoll = 25e6
If we slice it longitudinally in slices
Each slice: Ncoll=1e4-1e5 (in 170 um$^{2)}$
Filling ratio of ~2-10%

COLLOID
Modifies E field



E_{out}=k.$E_{in}e^{jphi}$

Amplitude reduction
Phase delay
Both dependent on n @ 20 keV

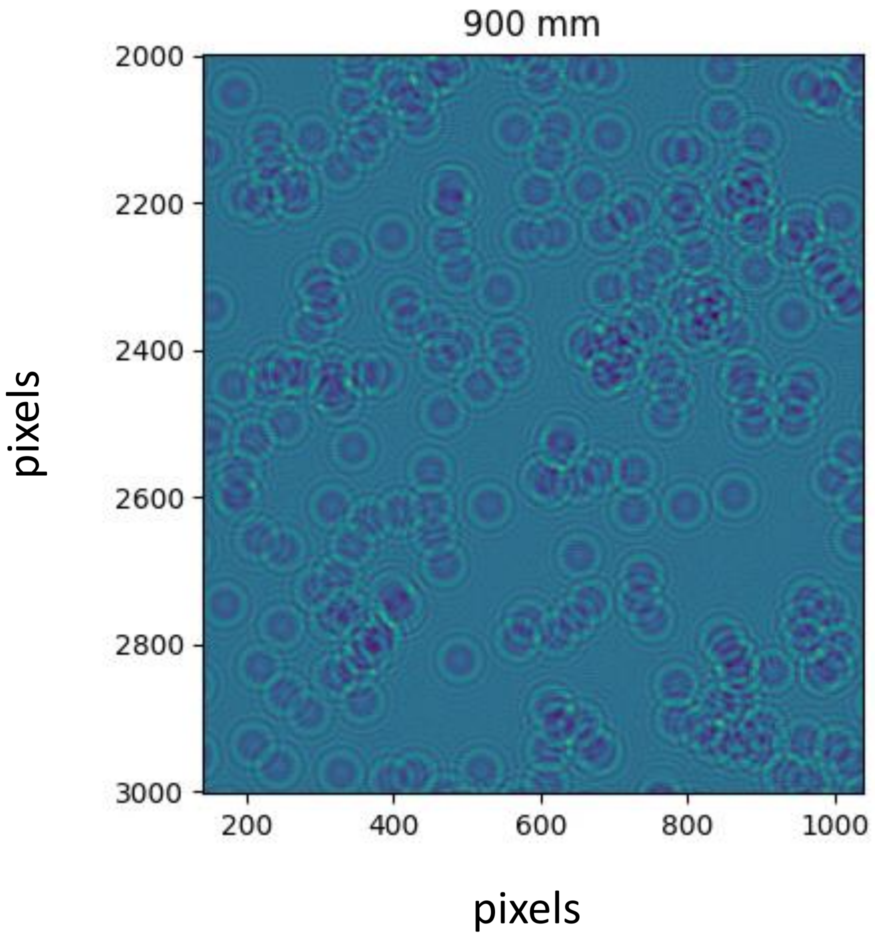
Could be estimated from the experimental ratio between water and colloids samples.

For the rest of this simulation k=0 (for simplicity)
Both k=0.999 and phi=1^o with 1e5 colloids were simulated and speckles were observed

Colloids

Achievement:

Speckles observed
Talbot in FFT observed
S(q) quantified
C(q)=1 by definition
(Single particle)



Colloids

Achievement:

Speckles observed
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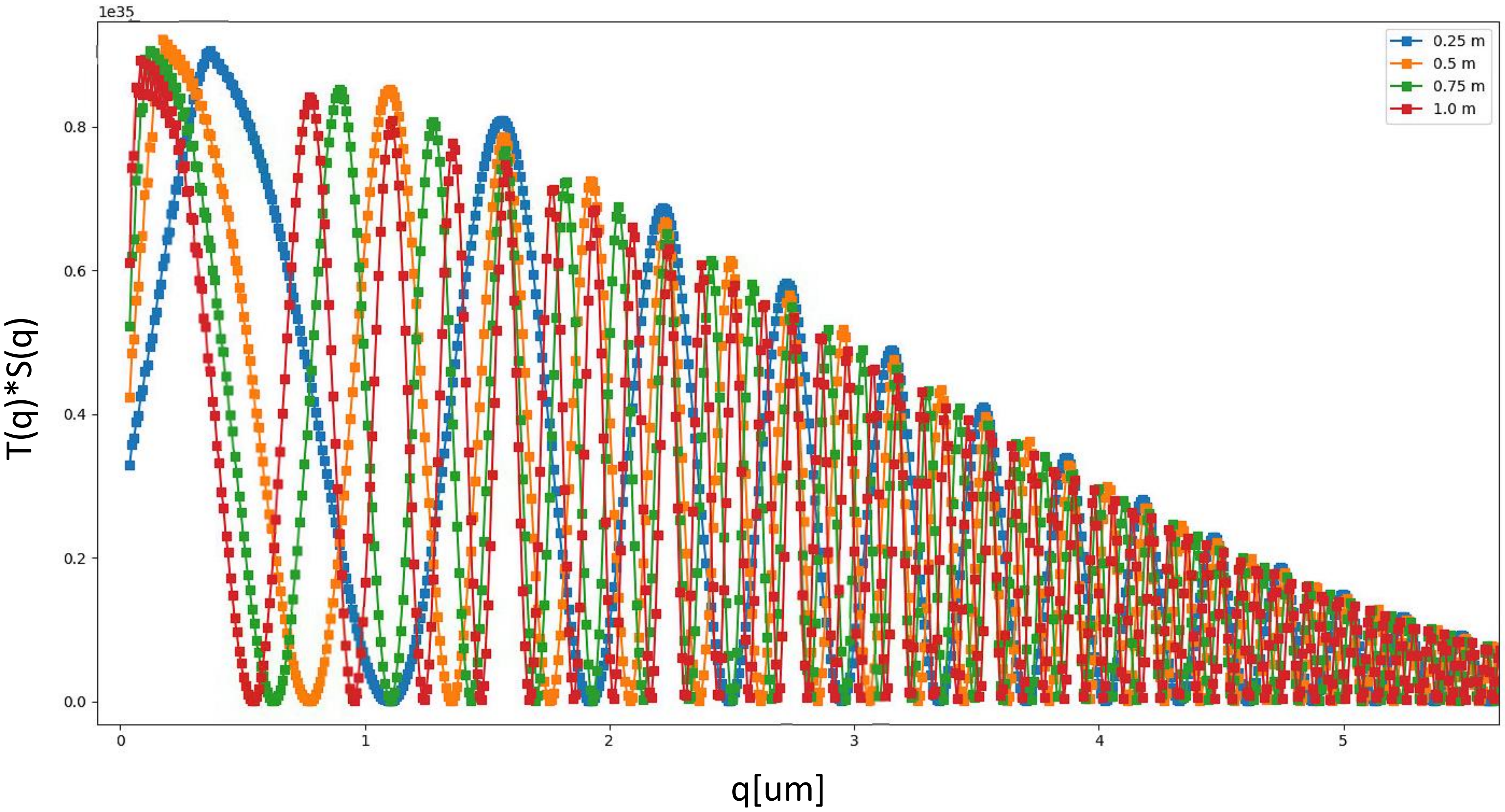
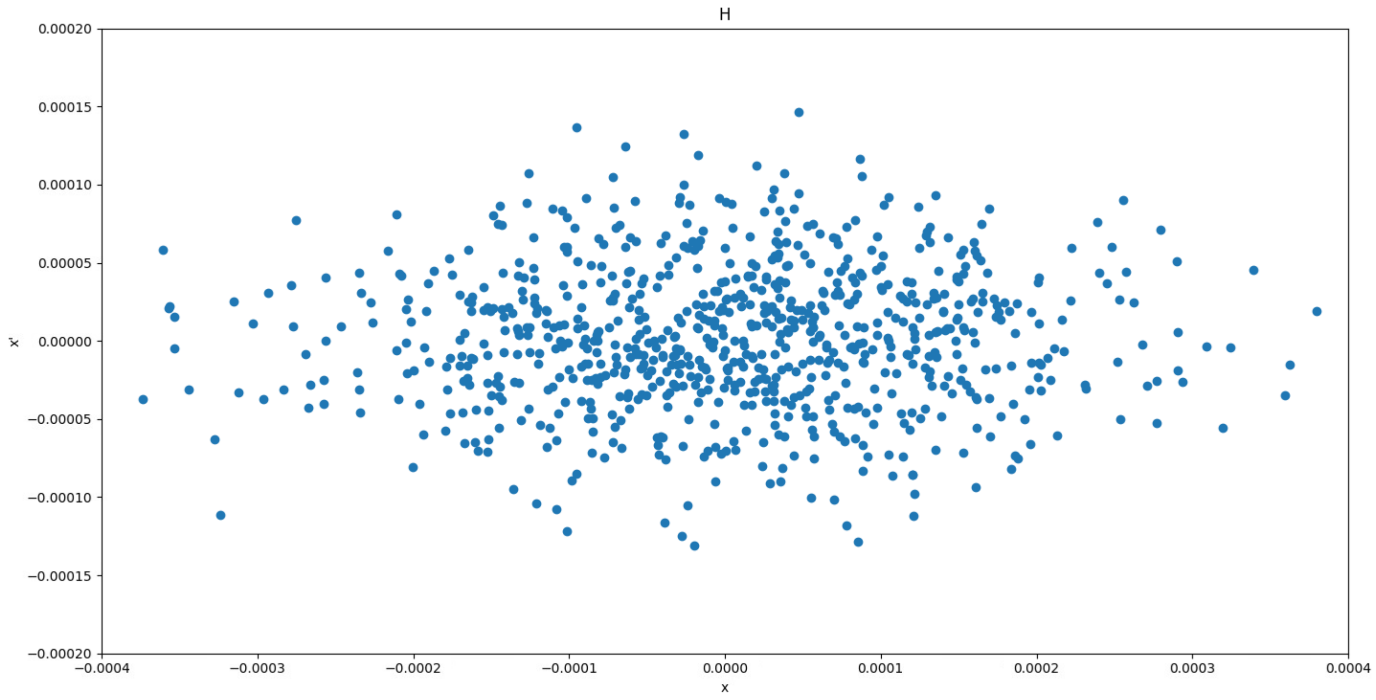
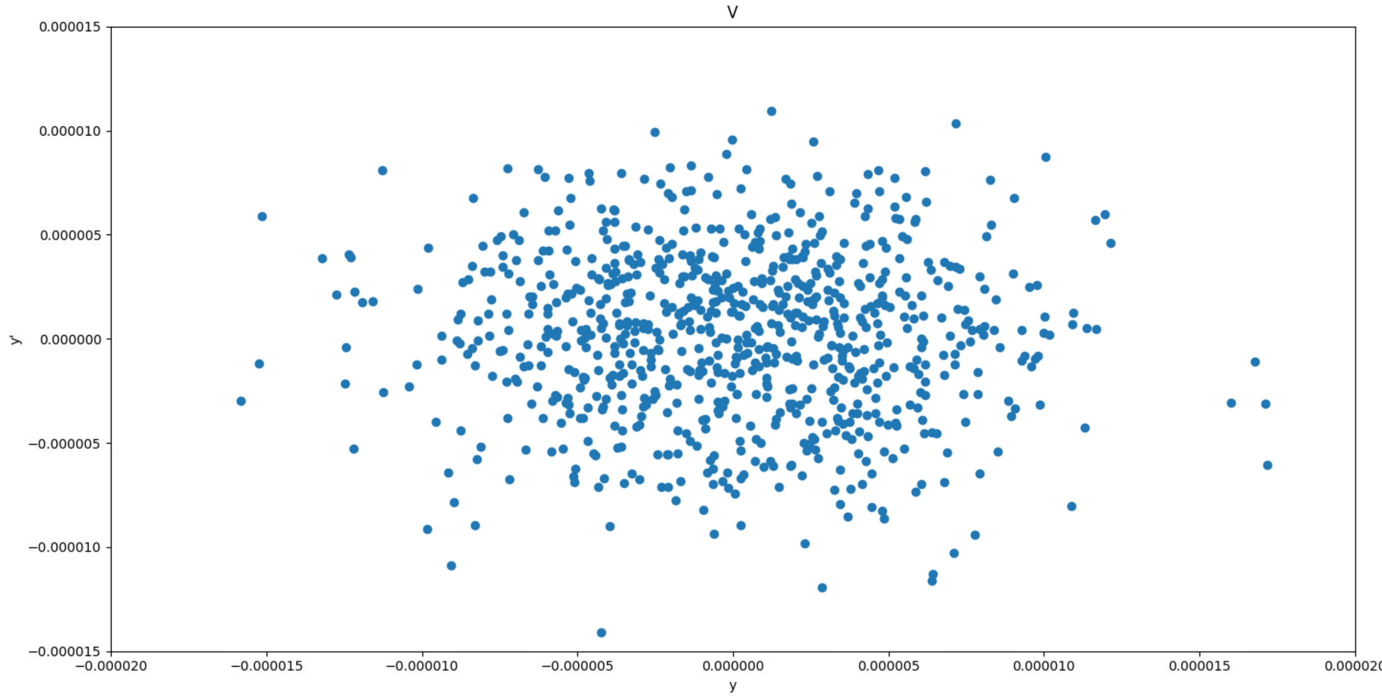


Simulated T(q)*S(q) at different distances for 20 KeV SR and 1 um colloid diameter

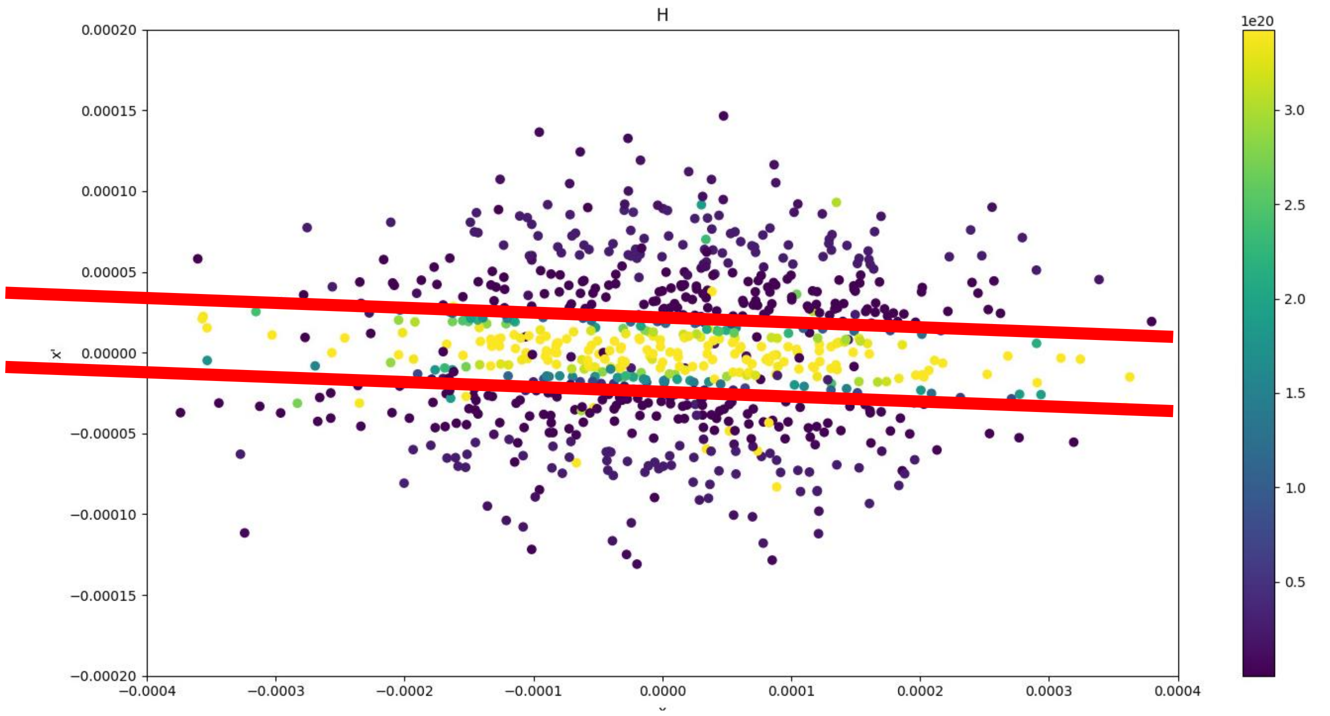
What is ALBA 'beam size'?

4 D Phase space

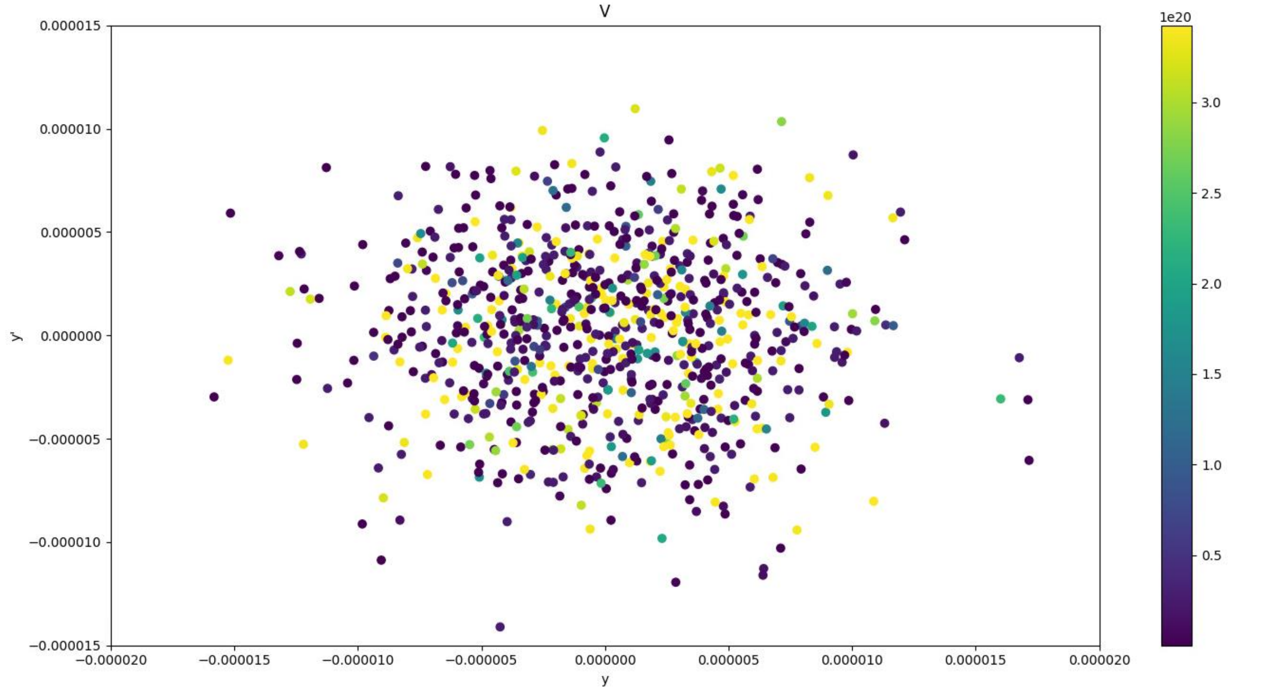




What is ALBA ‘beam size’?



4 D Phase space



Color coded:

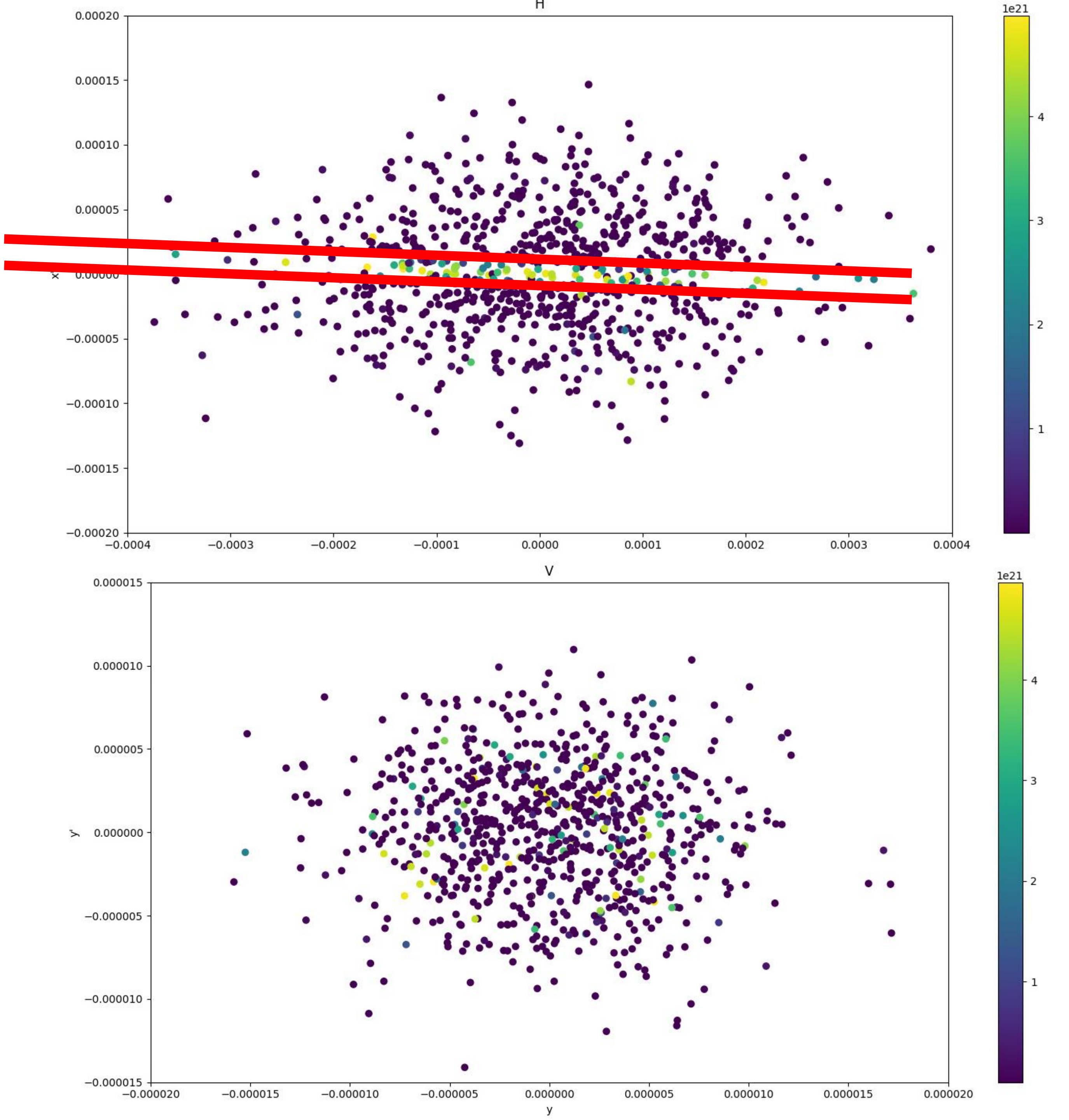
SR on the colloids plane after crossing the slit

What is ALBA 'beam size'?

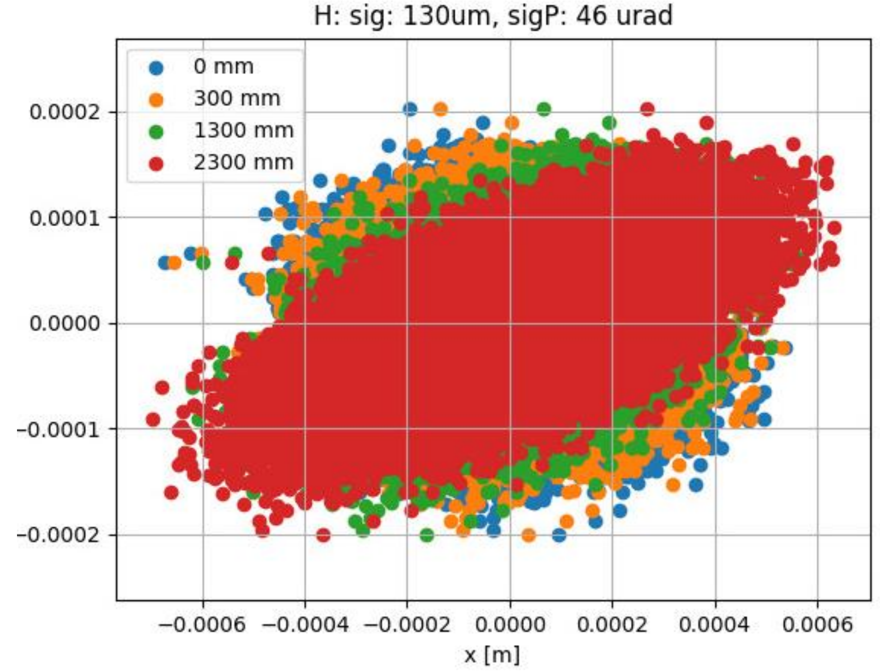
4 D Phase space

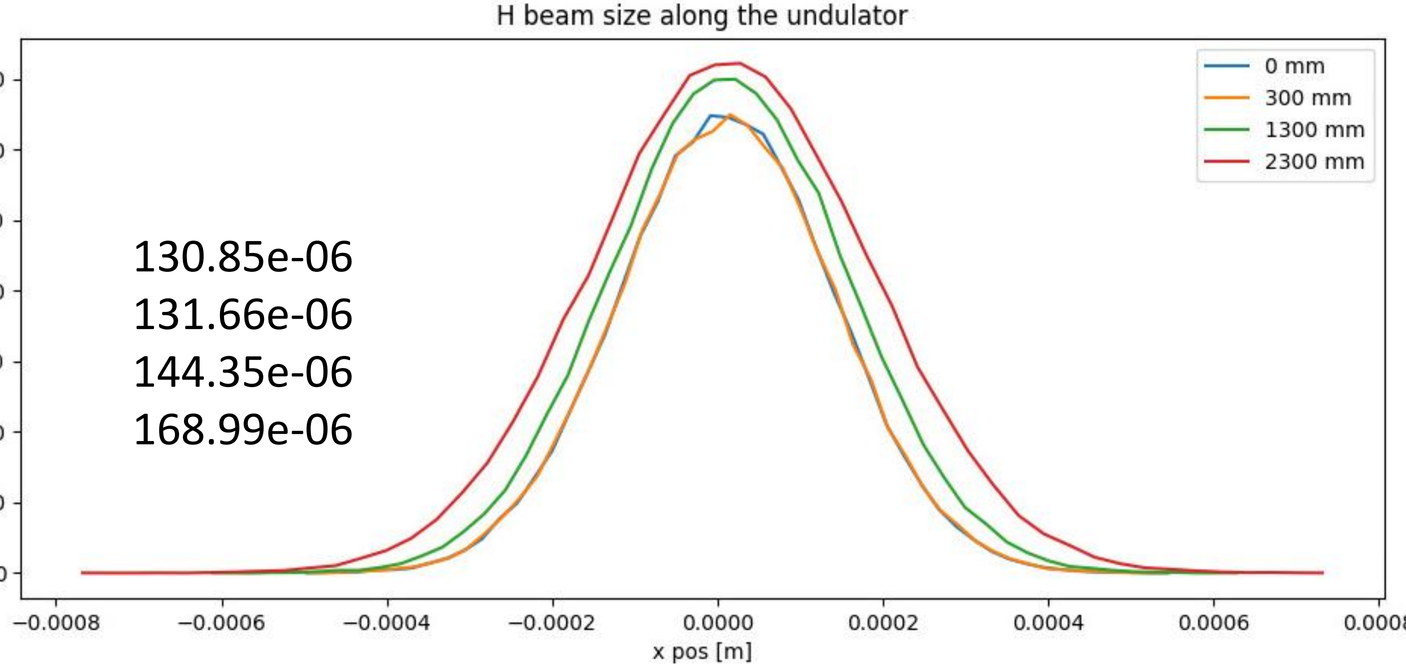
Color coded:

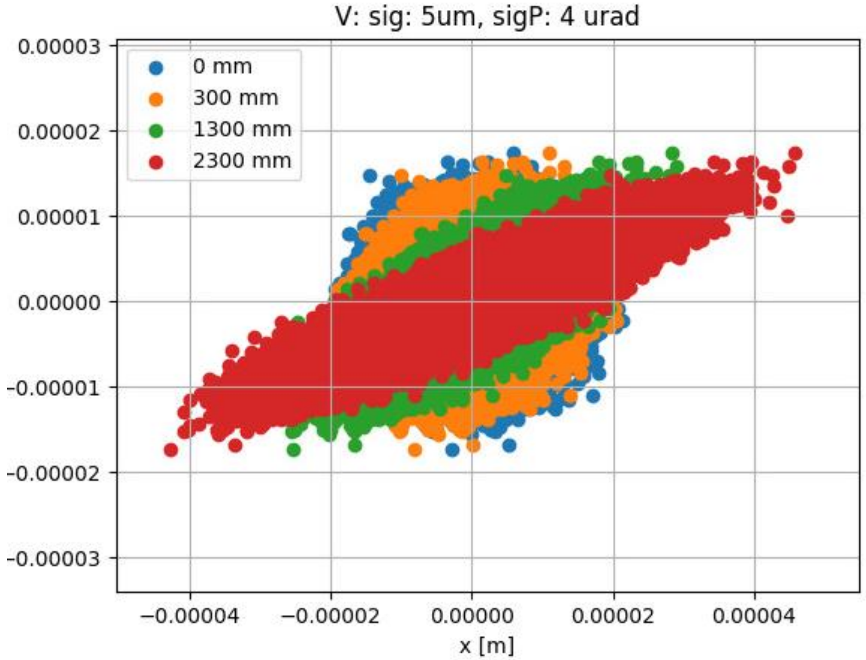
SR on the detector plane only inside the FOV

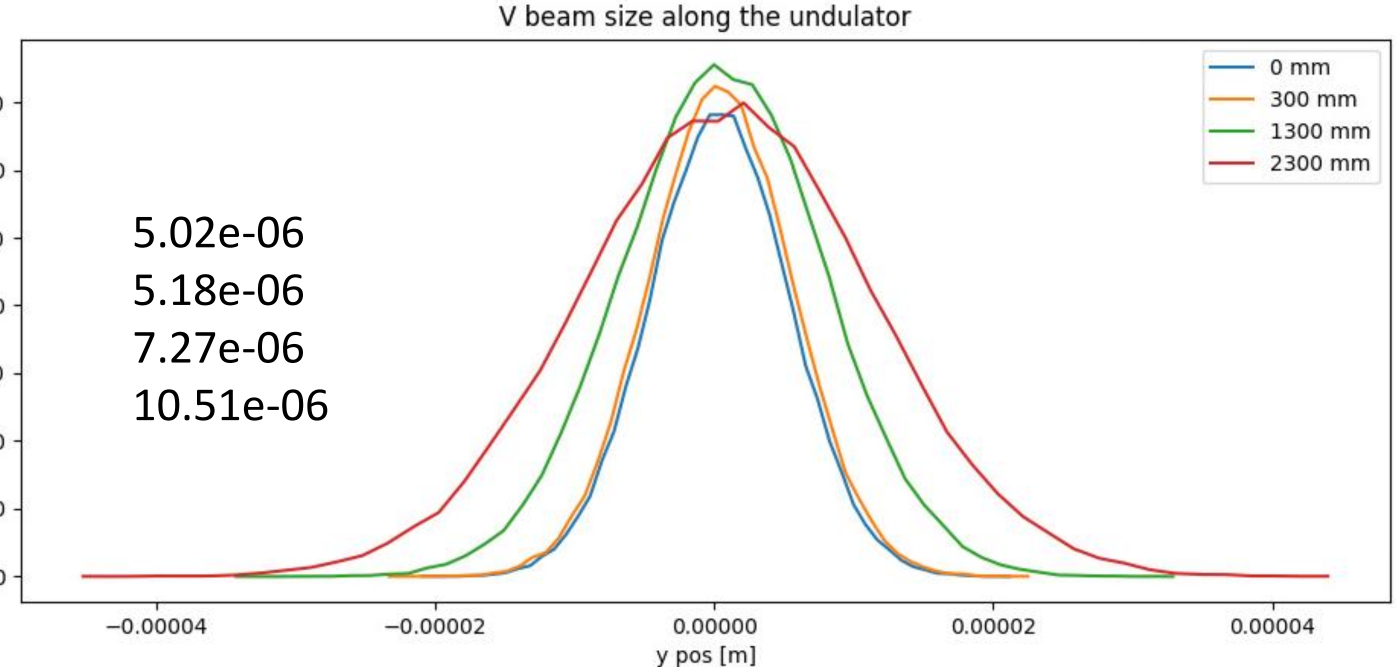


What is ALBA 'beam size'?



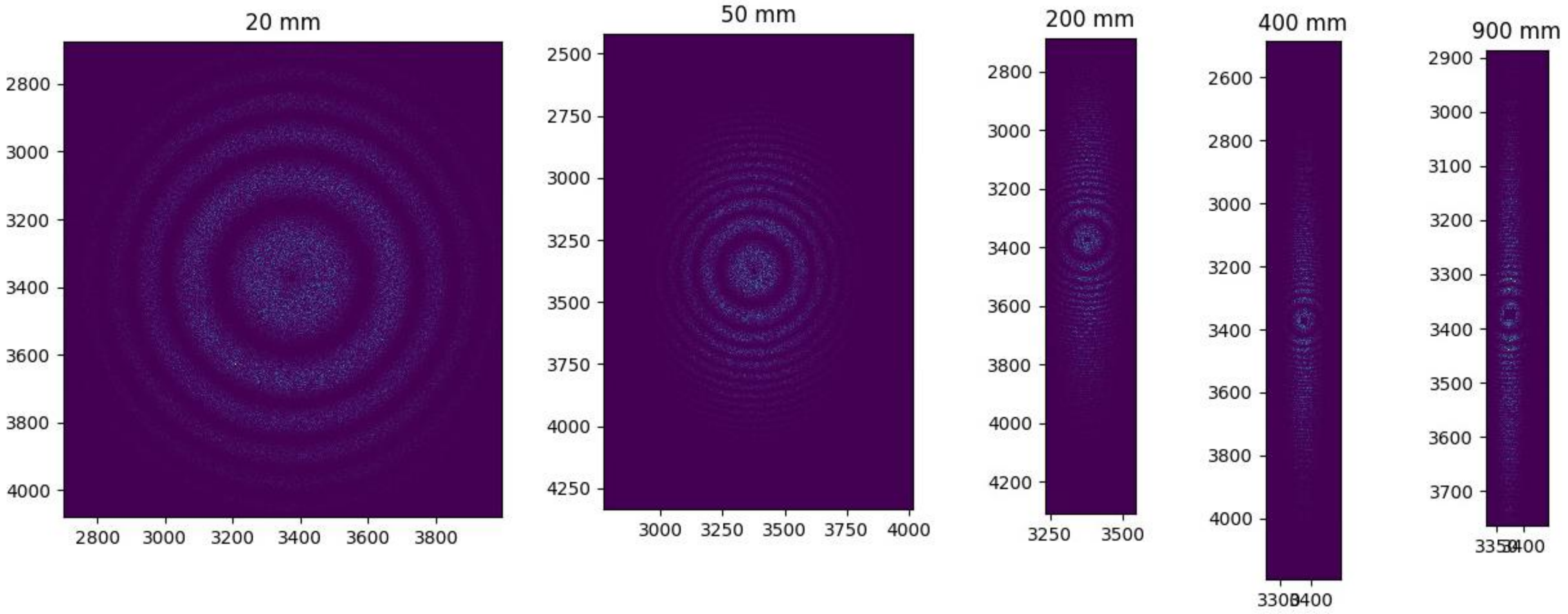






SIMULATION A

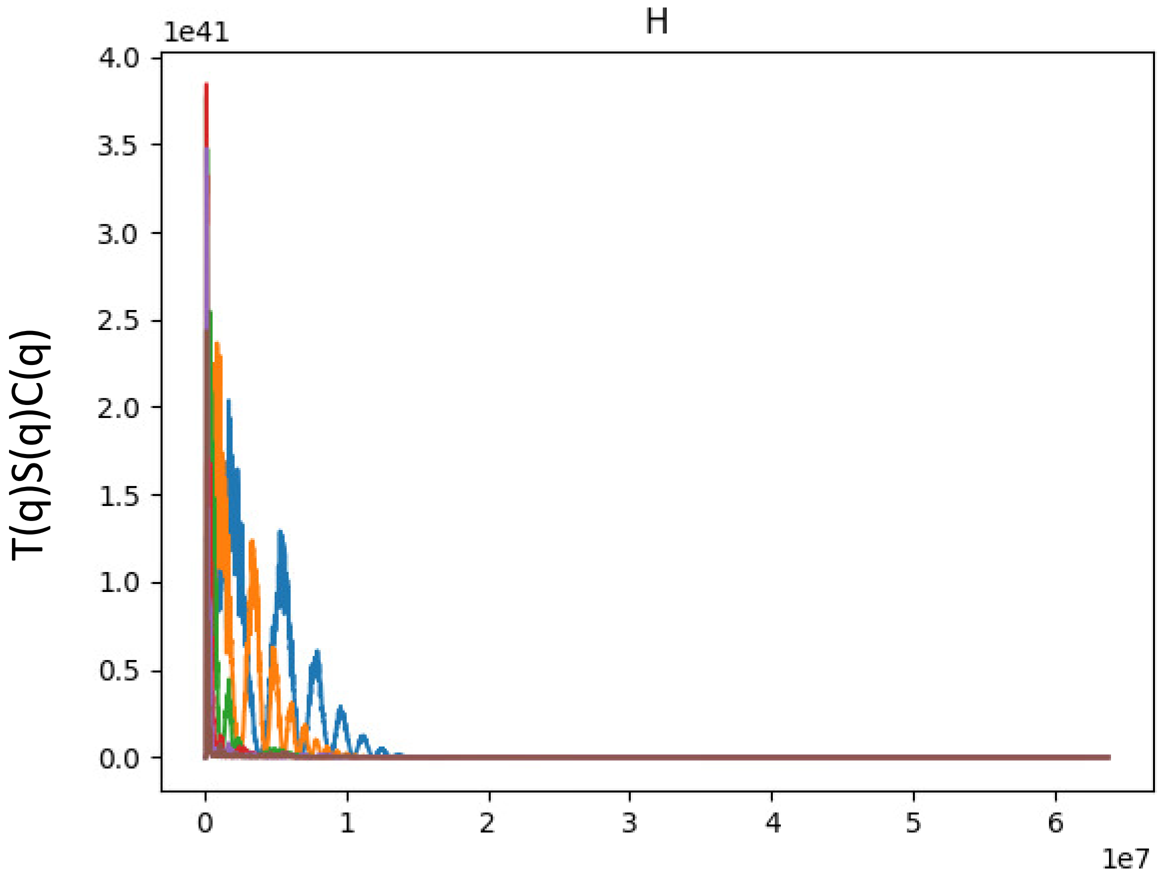
Distance scan

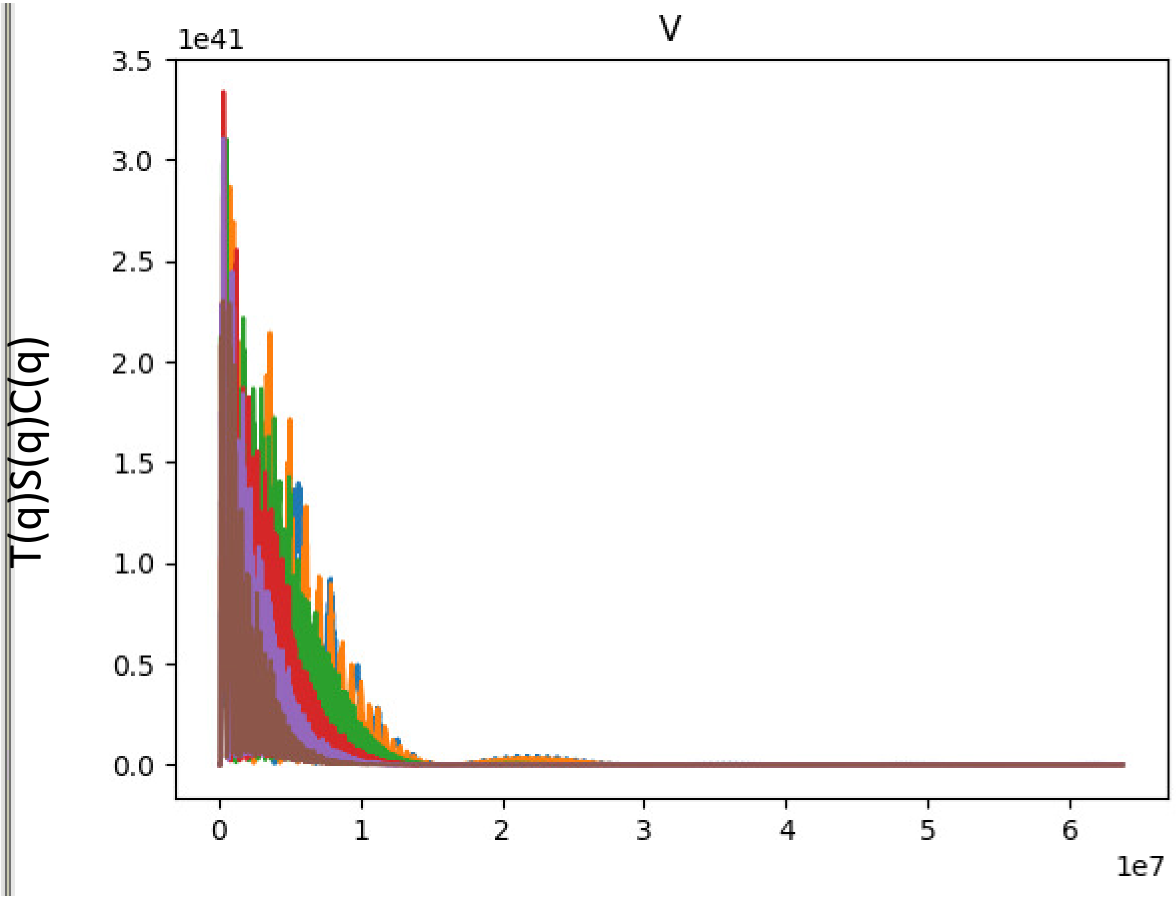


C(q) effect is more appreciable

SIMULATION A

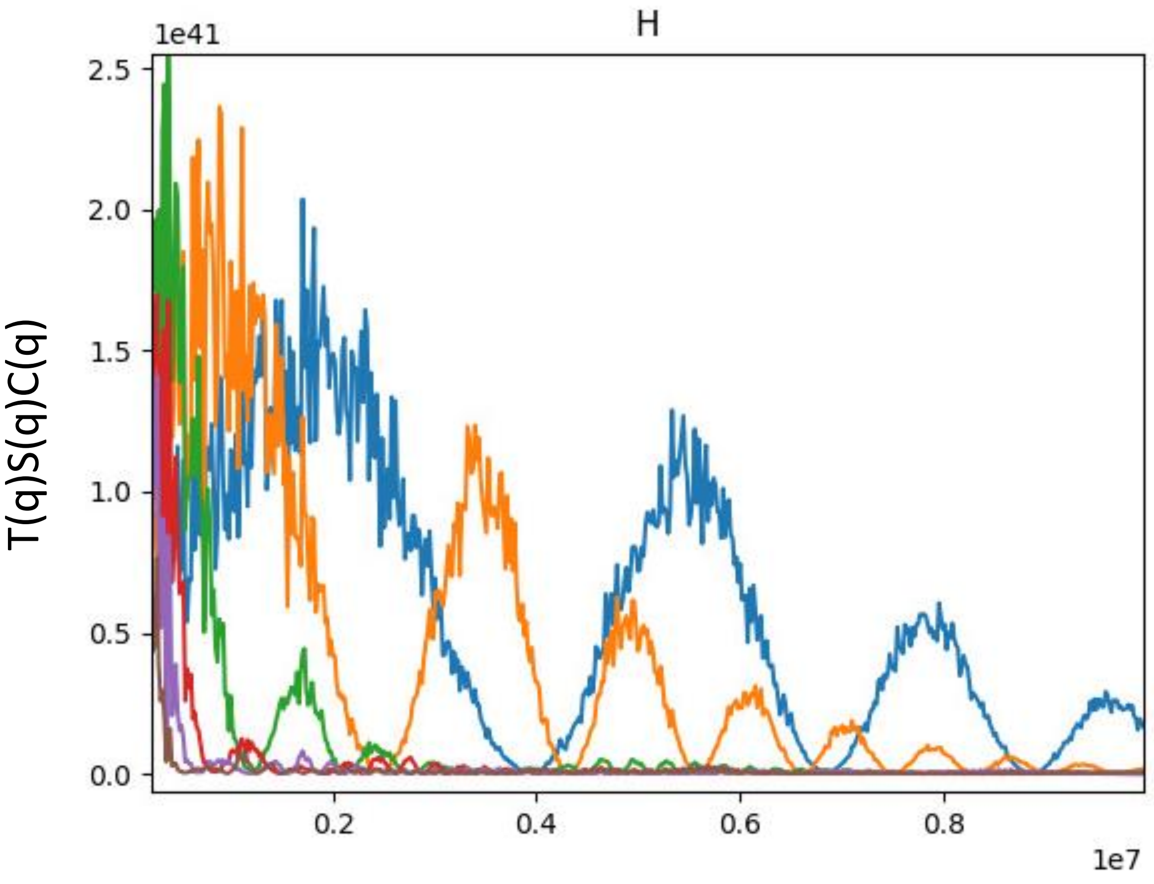
Distance scan

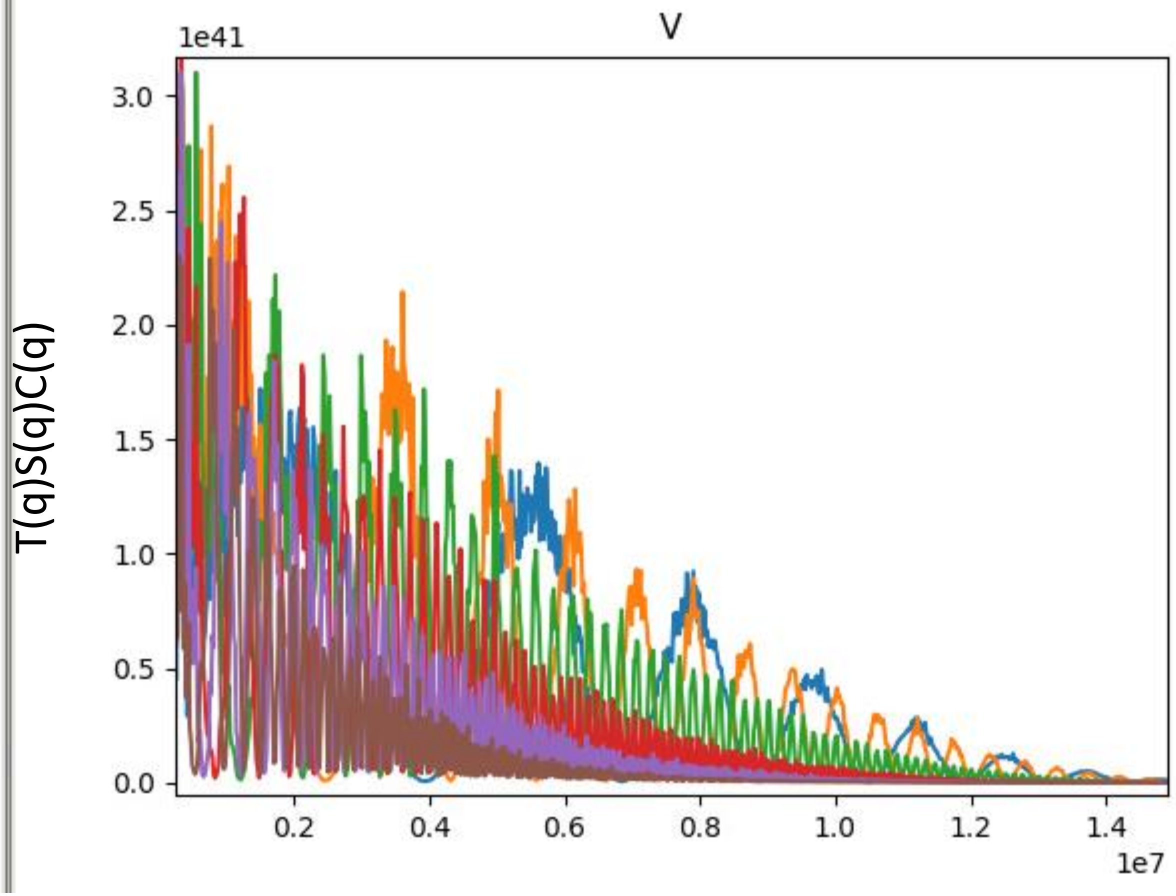




SIMULATION A

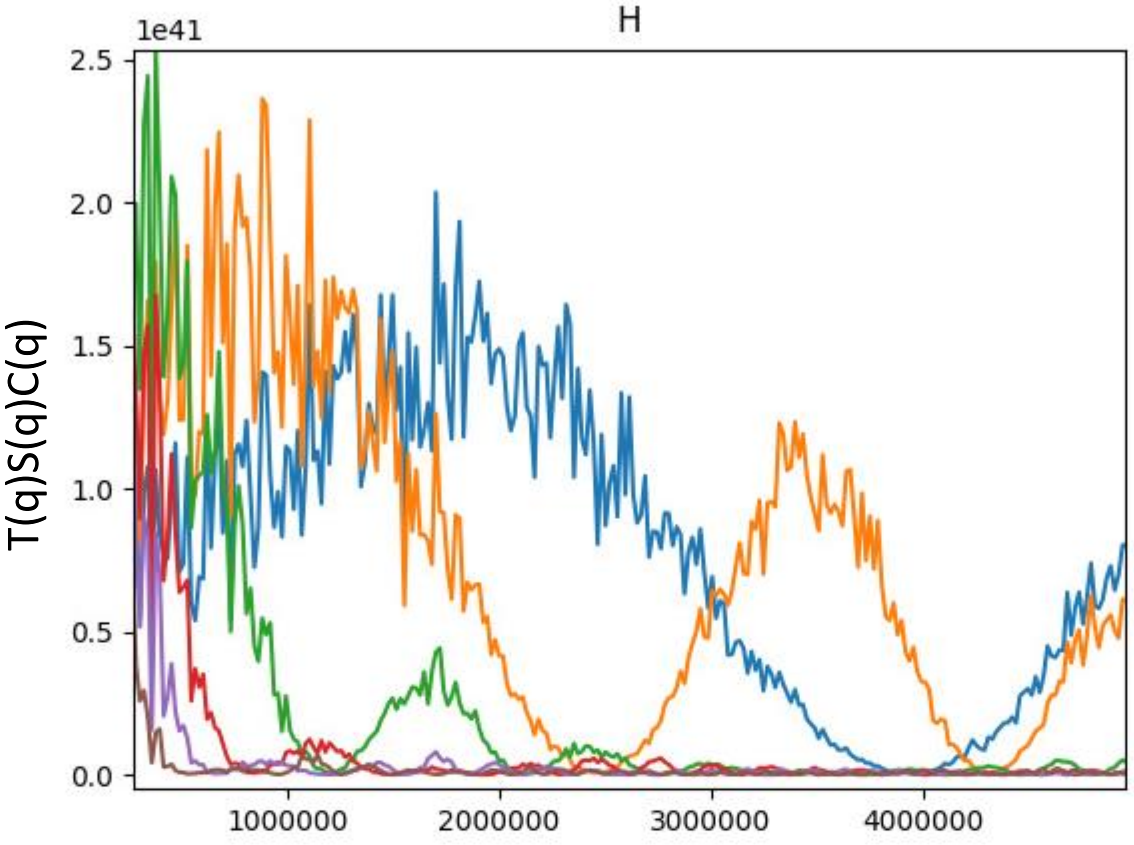
Distance scan

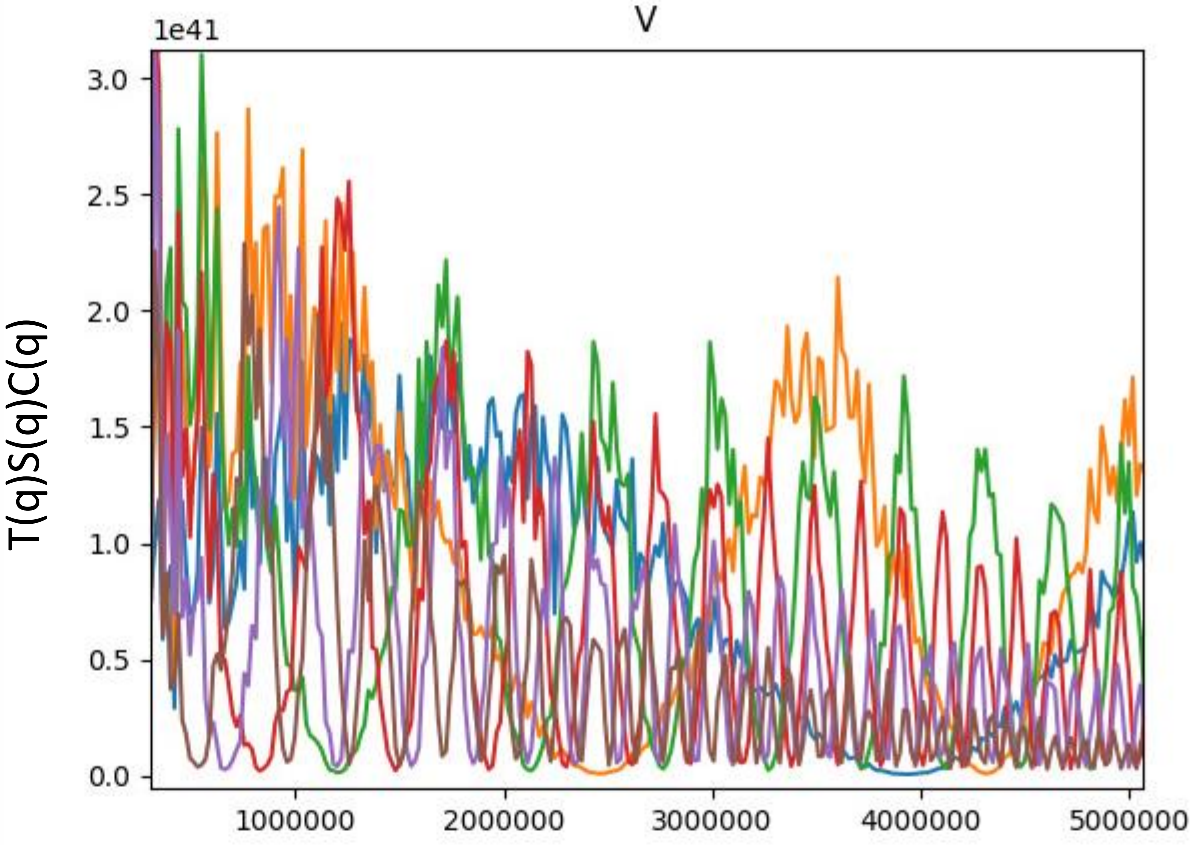




SIMULATION A

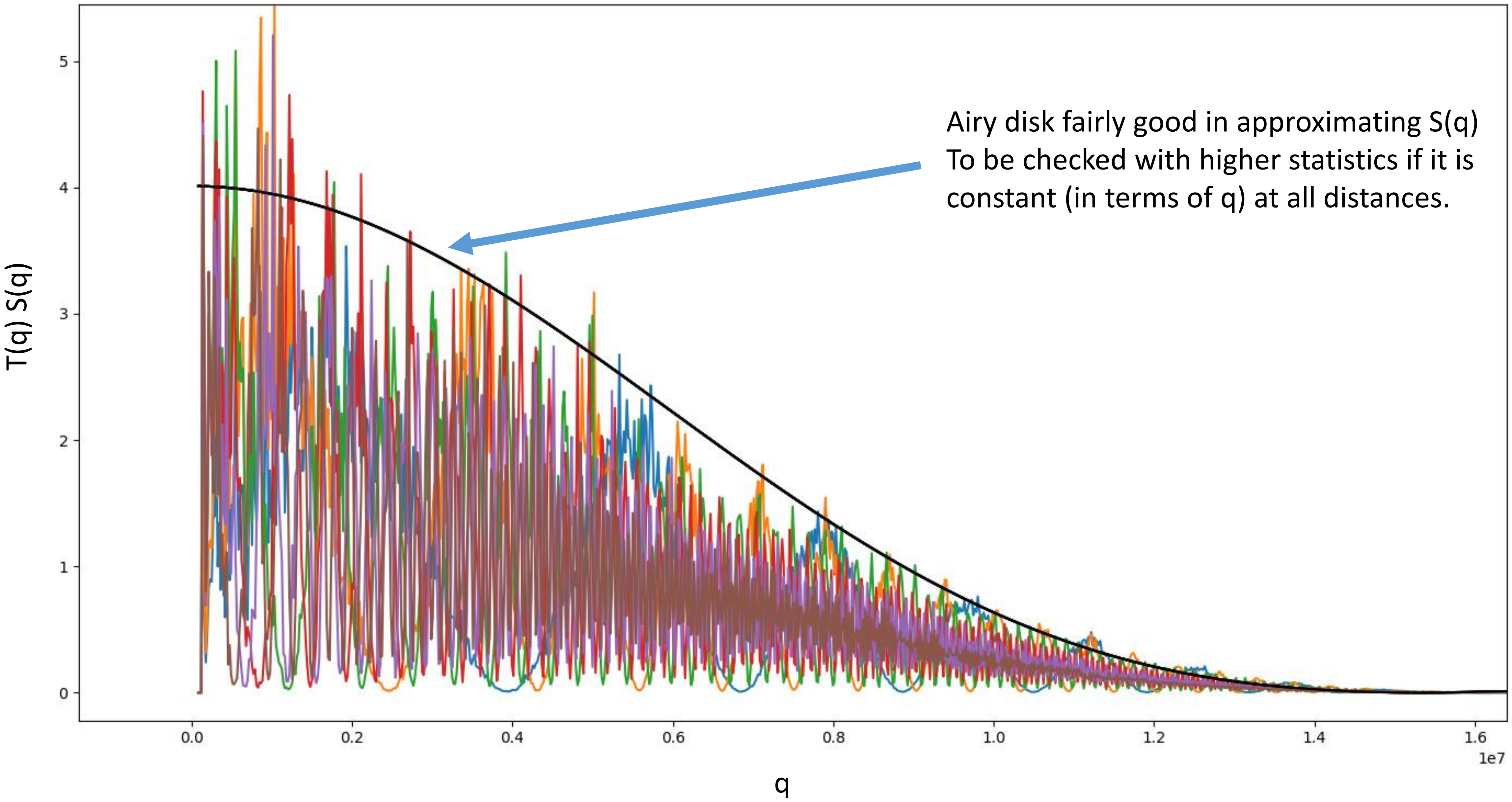
Distance scan





SIMULATION A

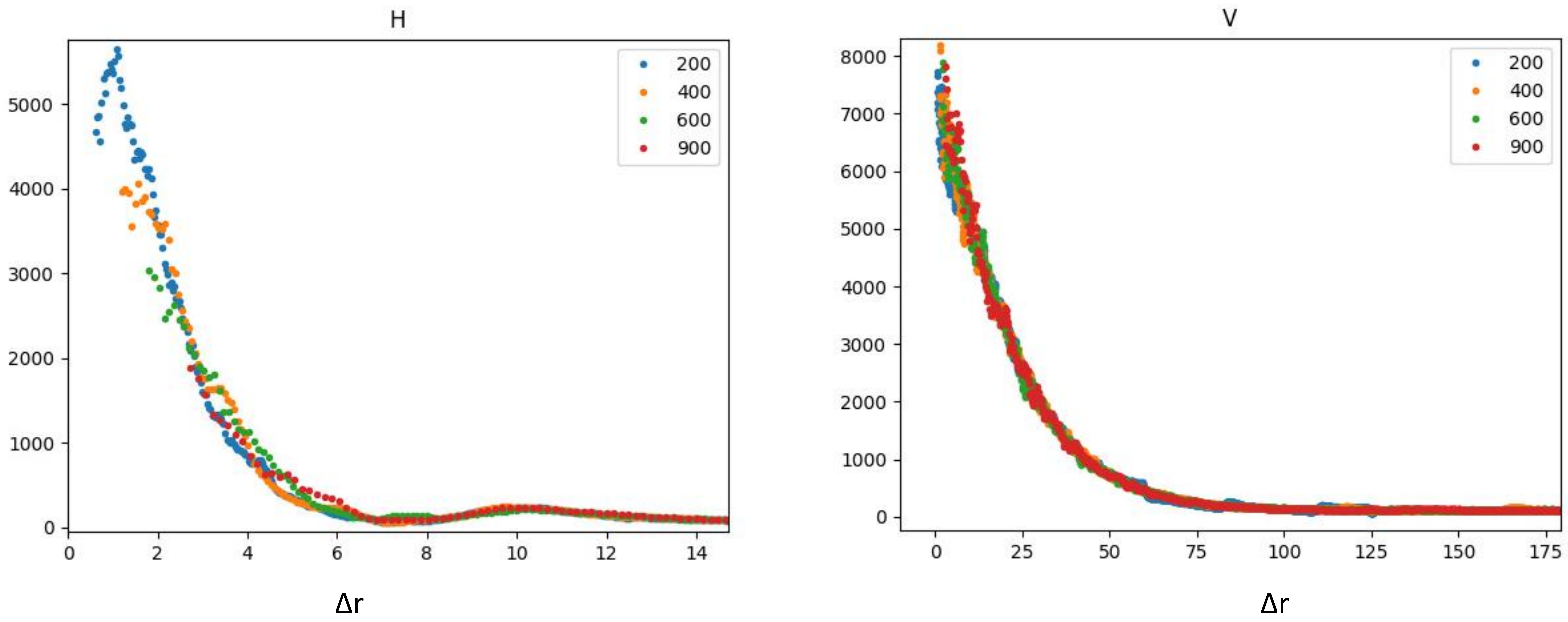
Decay for single particle taken as a reference



SIMULATION A

Closing the loop

$$C(q) = [T(q)*S(q)*c(q)]_{BEAM} / [T(q)*S(q)]_{refParticle}$$

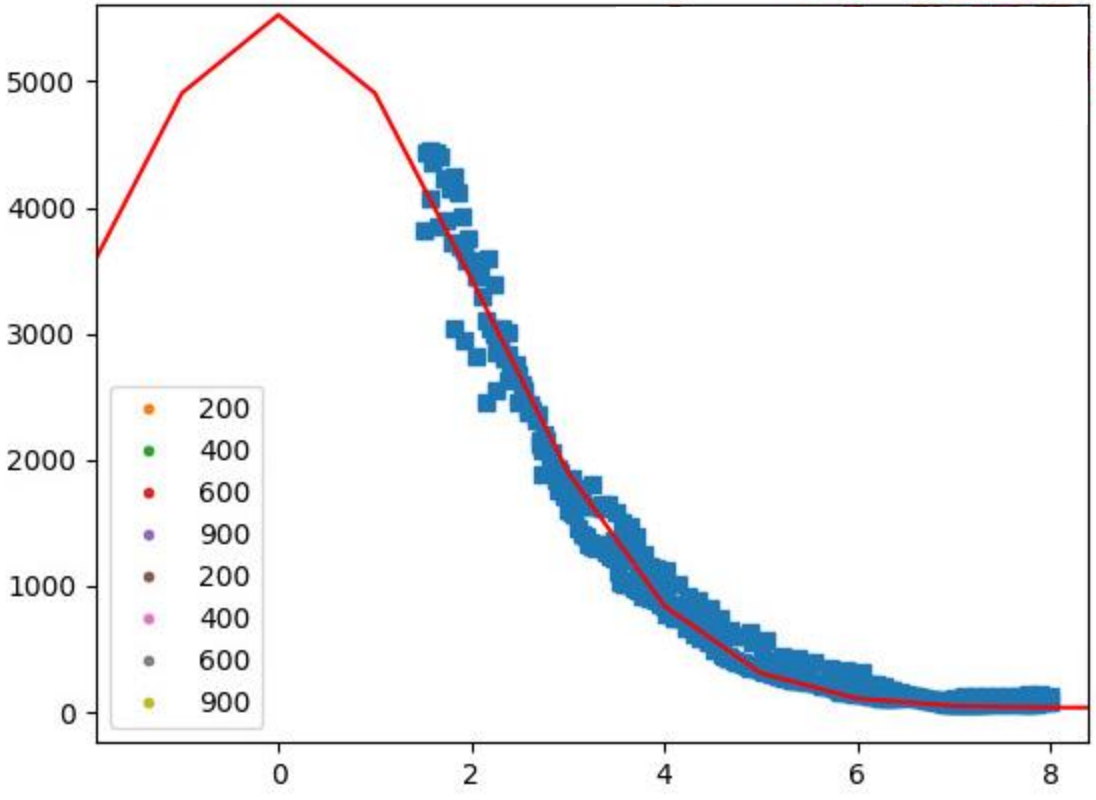


Curves from all distances collapse!

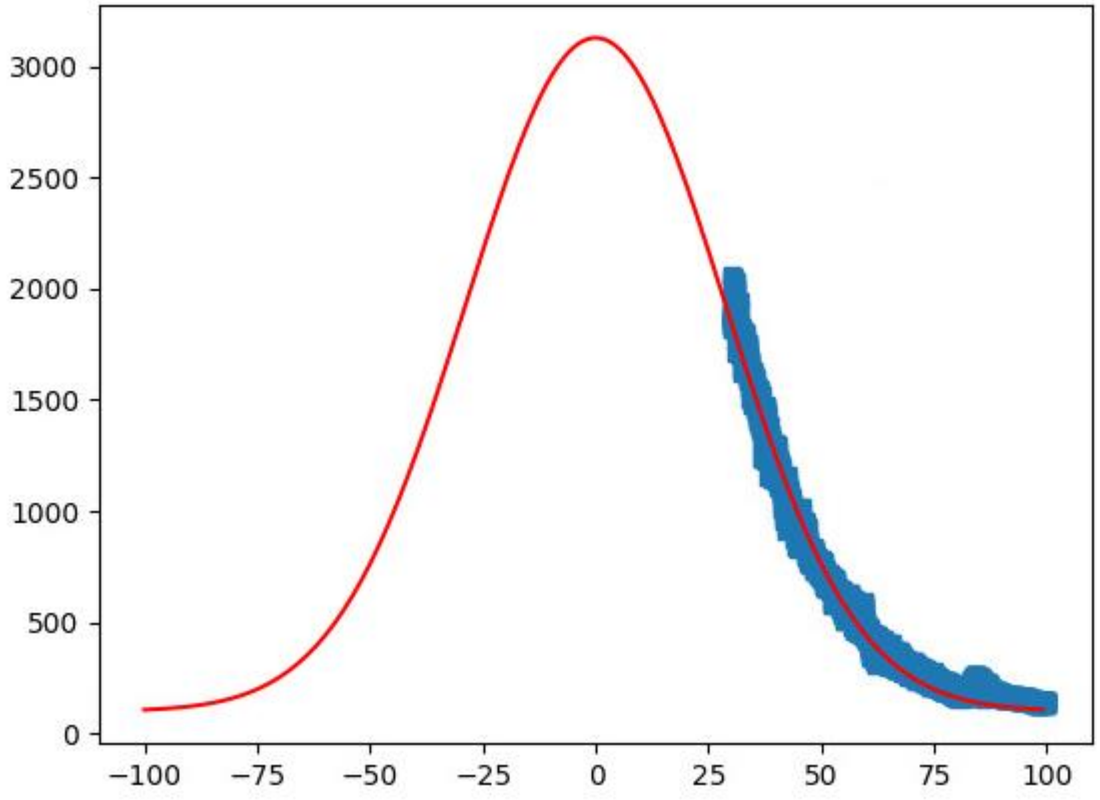
Closing the loop

SIMULATION A

$$C(q) = [T(q)*S(q)*c(q)]_{BEAM} \;/\; [T(q)*S(q)]_{refParticle}$$



Δr



Δr

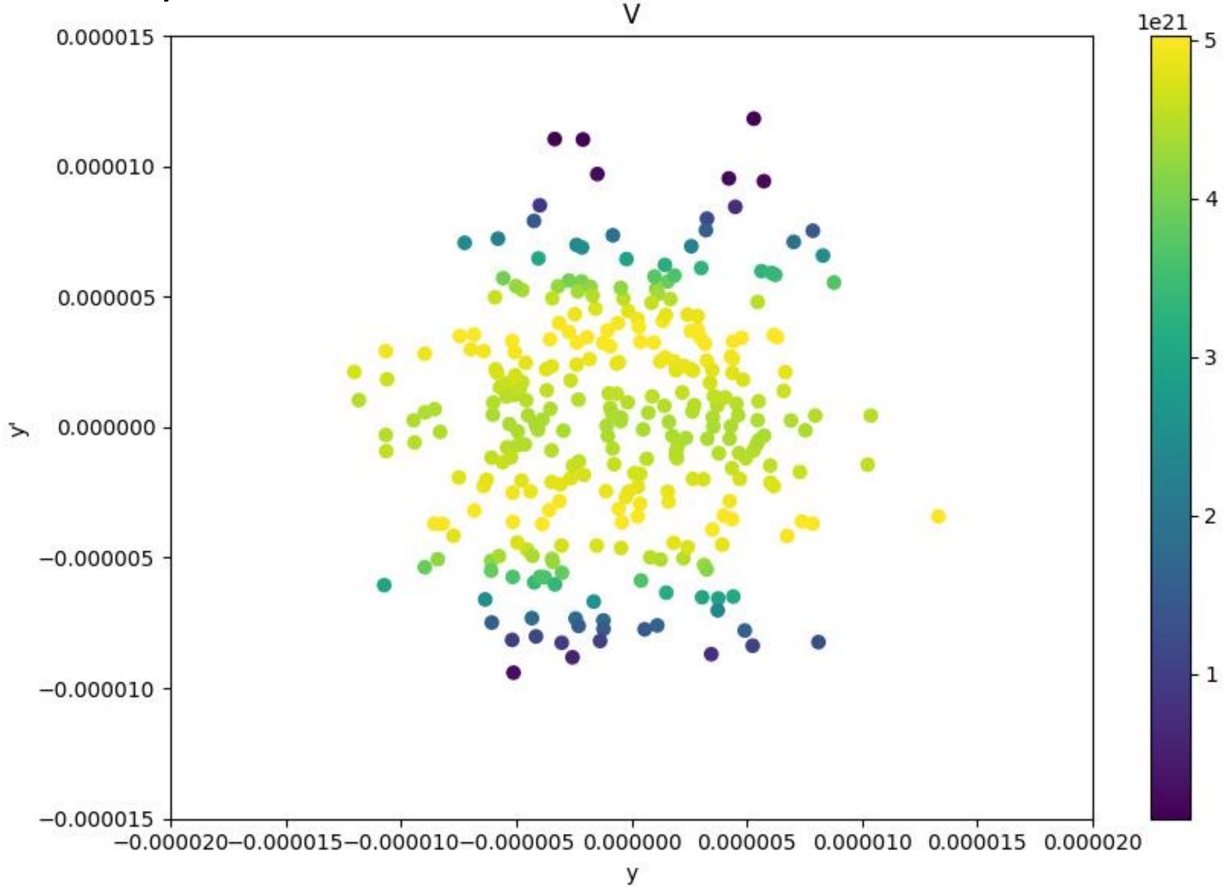
Potentially beam size reconstruction is possible
Highly dependent on lower cut in q
=> More Statistics are needed!

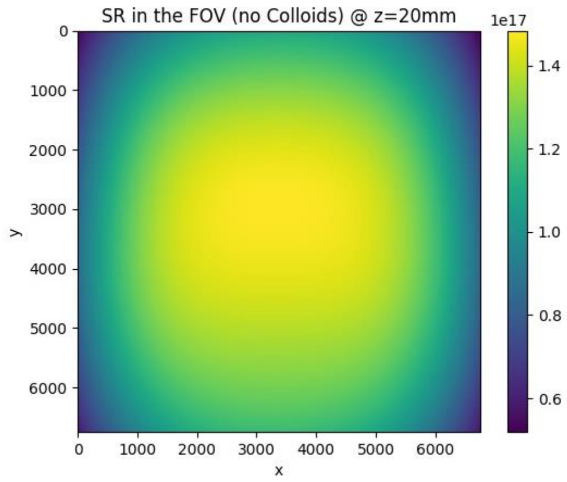
SIMULATION B

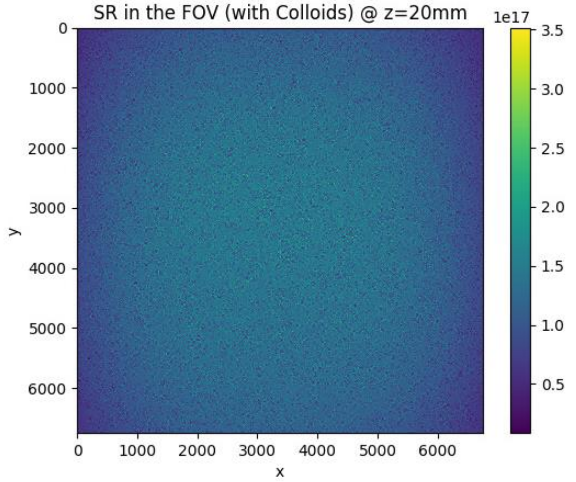
sigX = 0
sigXp = 0
sigY = 5e-6
sigYp = 4e-6

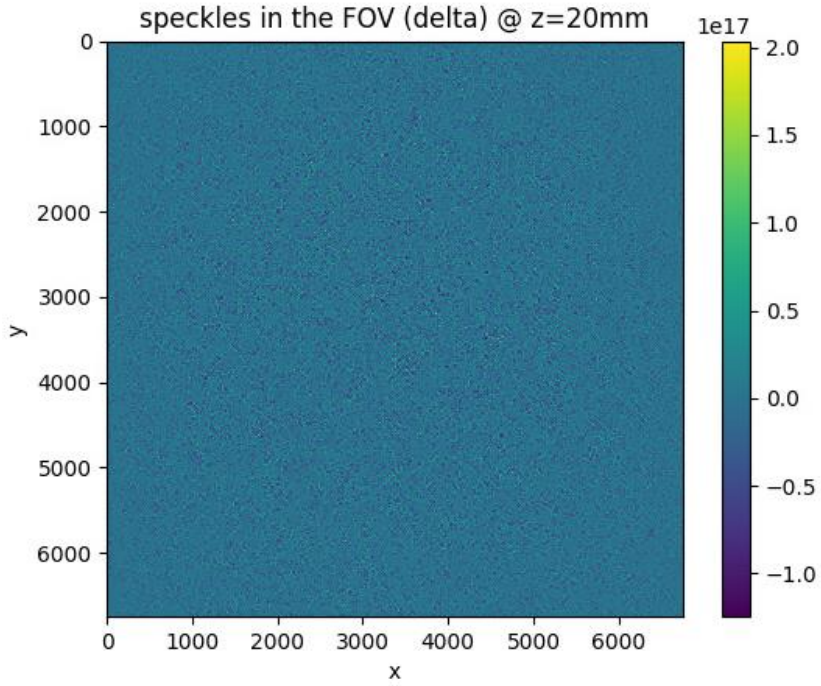
300 particles

SR Intensity in FOV









SIMULATION B

sigX = 0

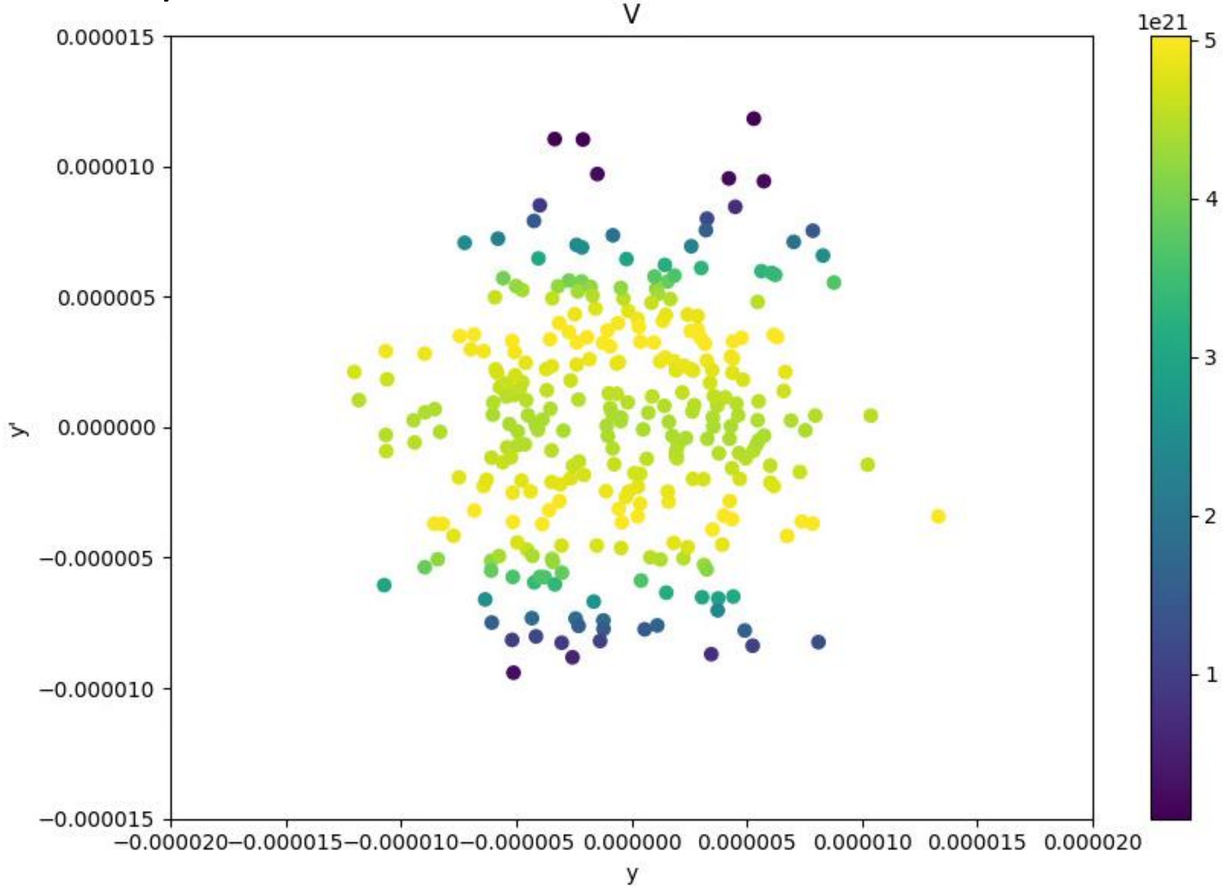
sigXp = 0

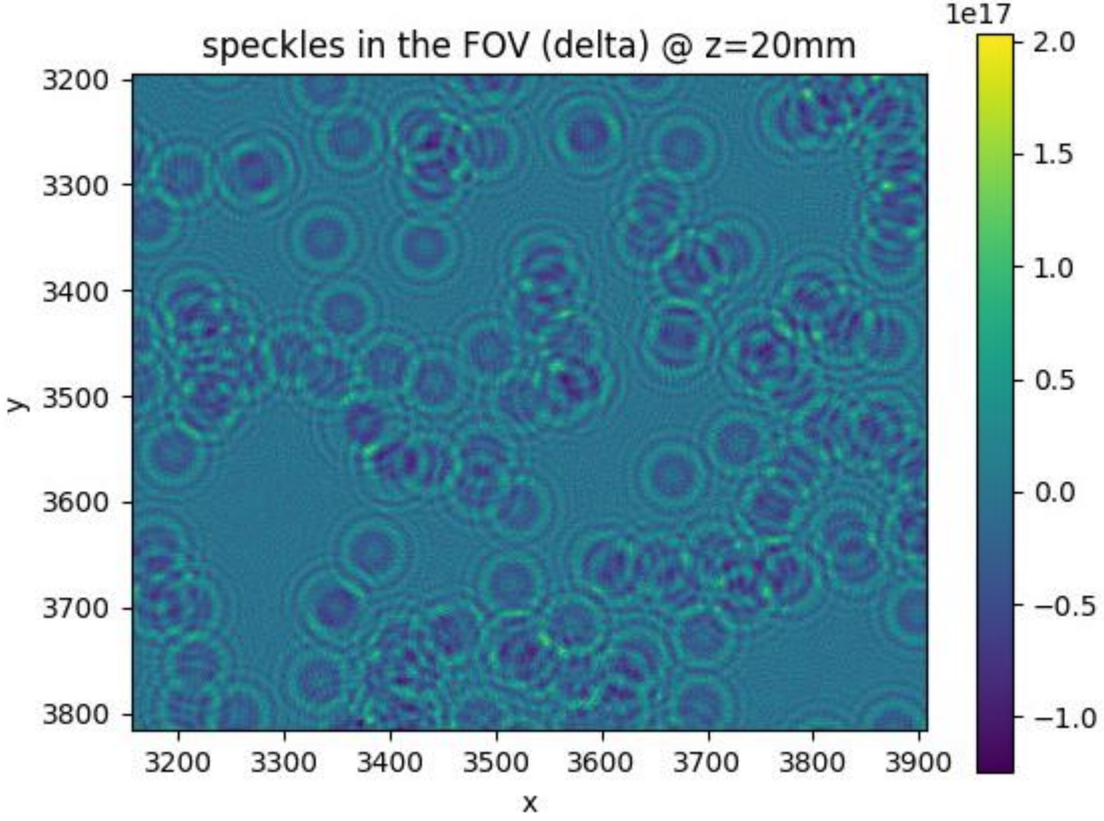
sigY = 5e-6

sigYp = 4e-6

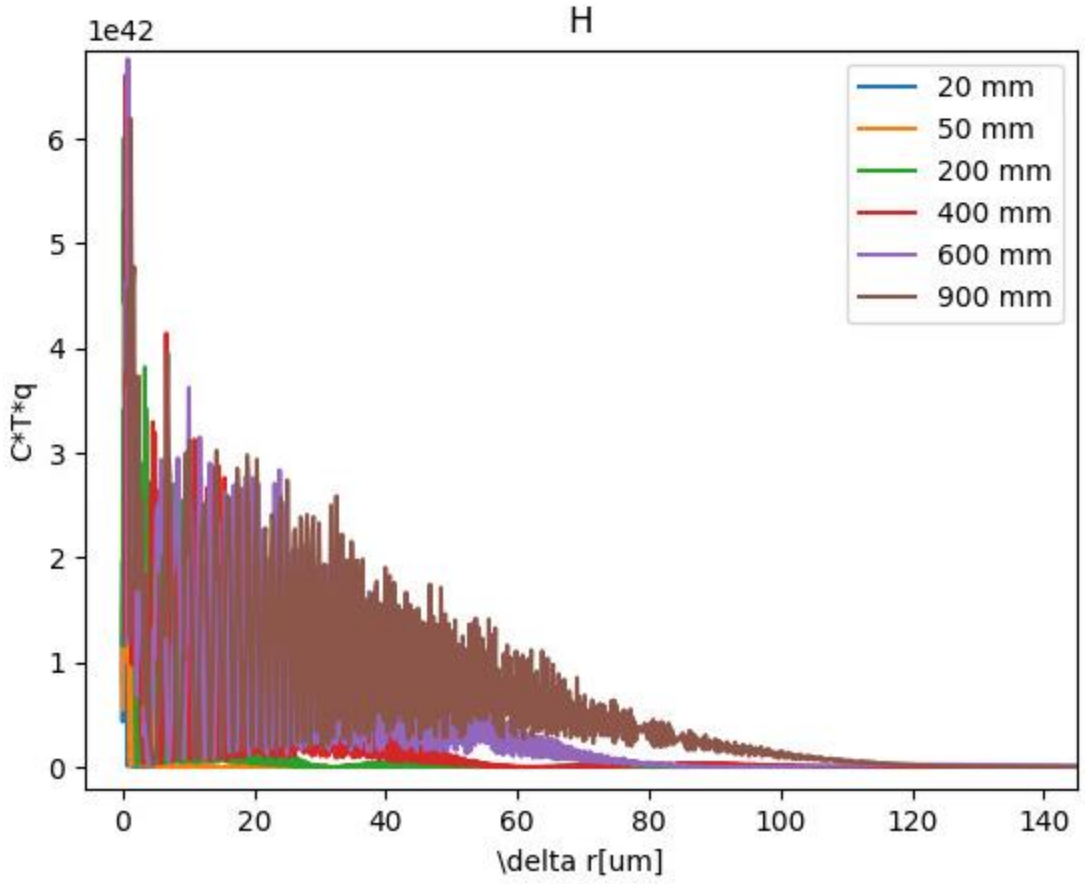
300 particles

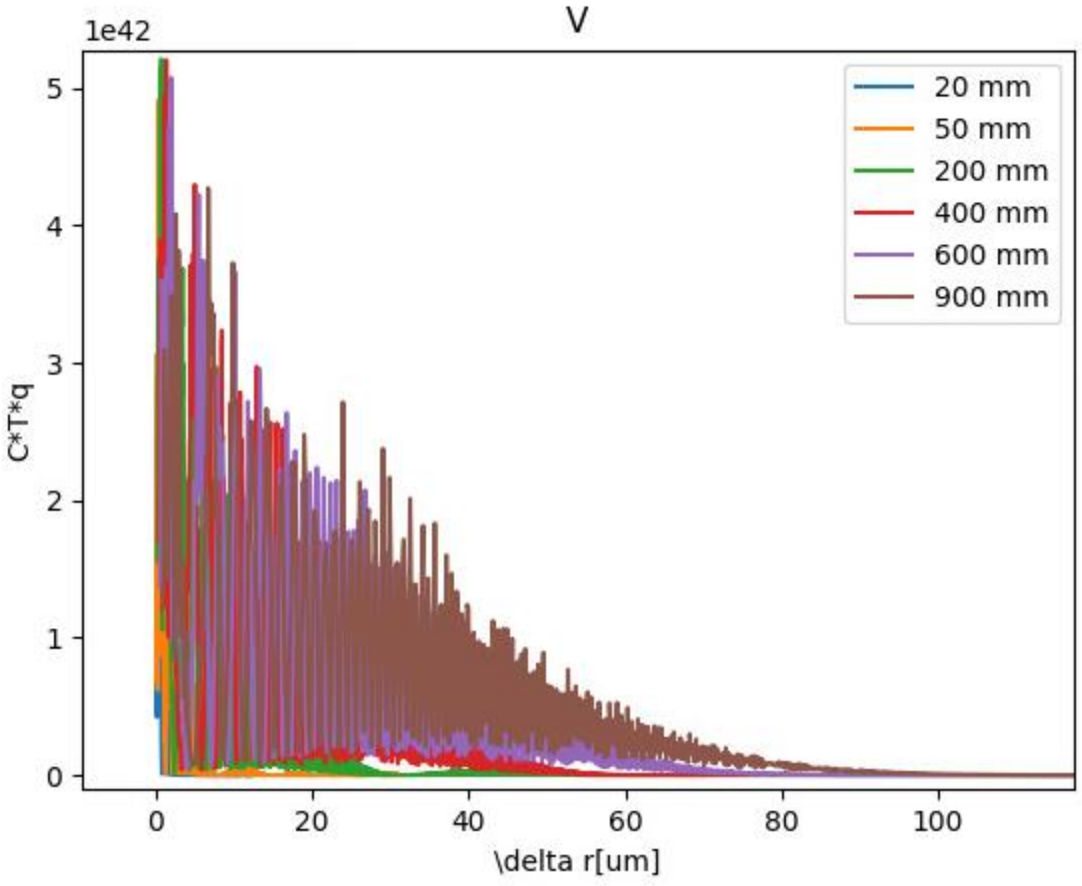
SR Intensity in FOV



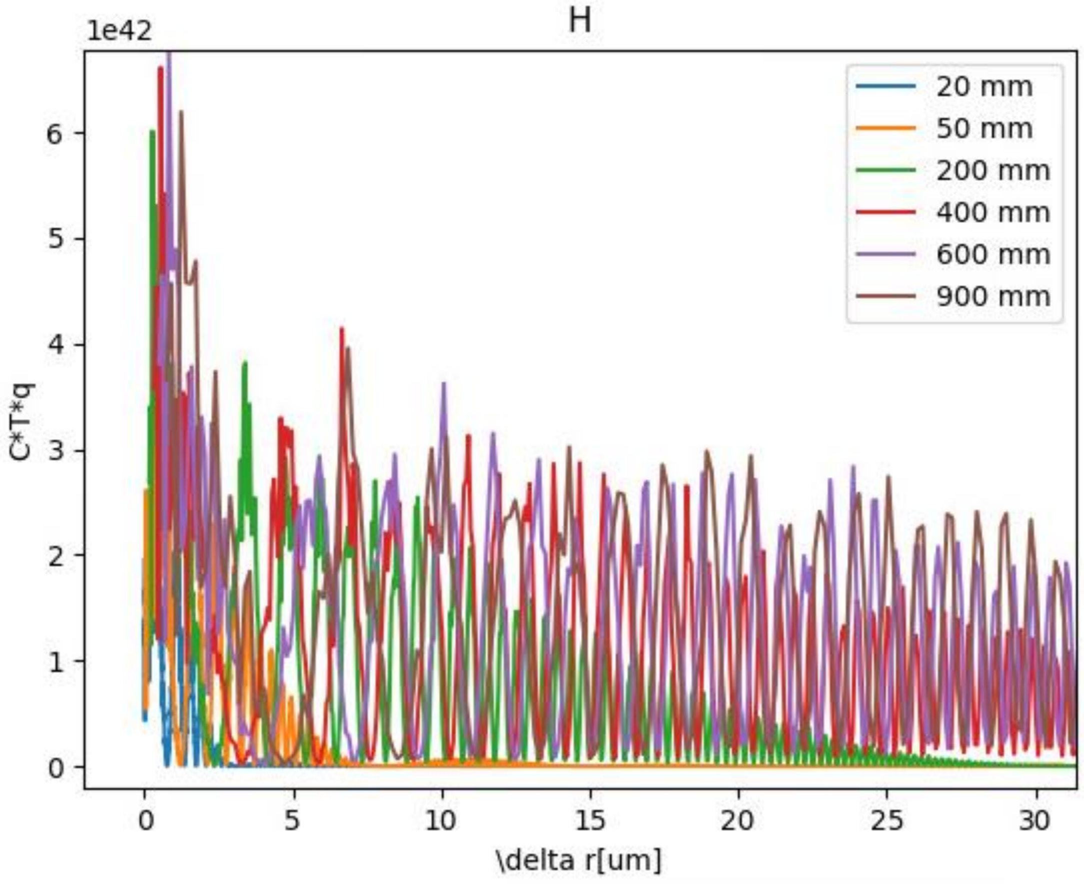


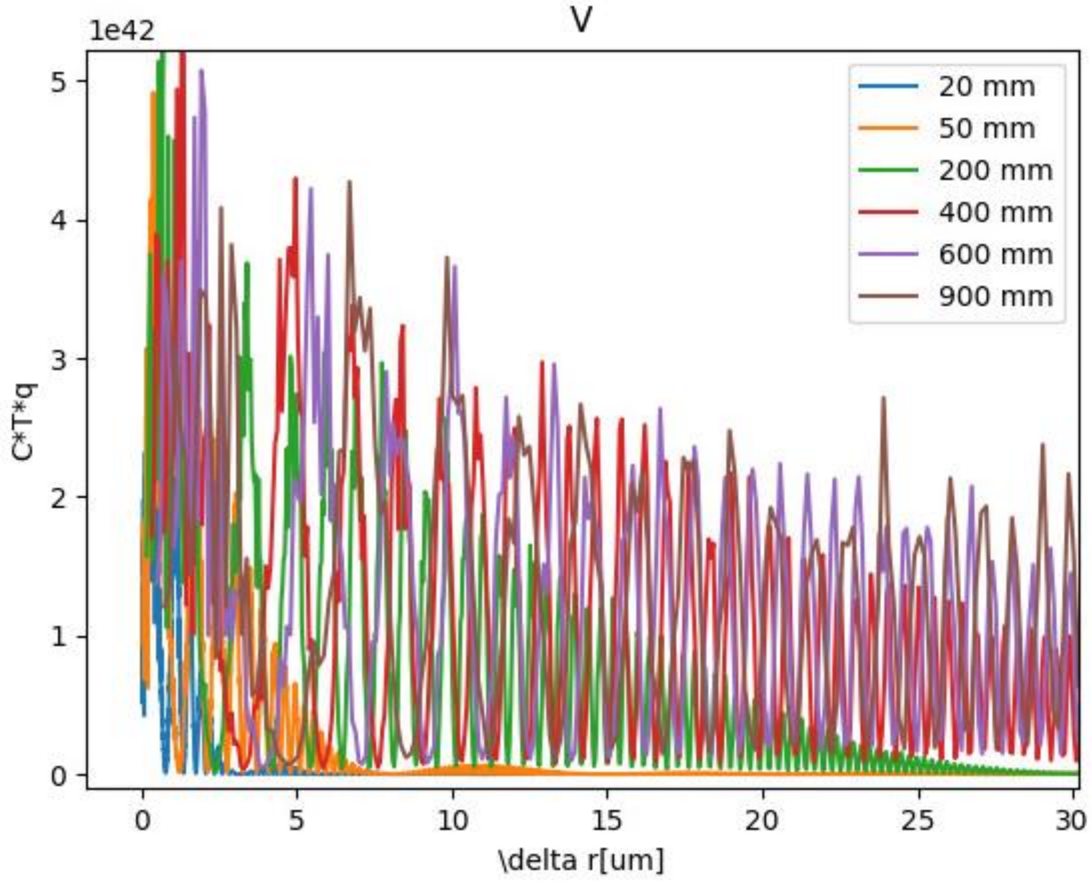
SIMULATION B



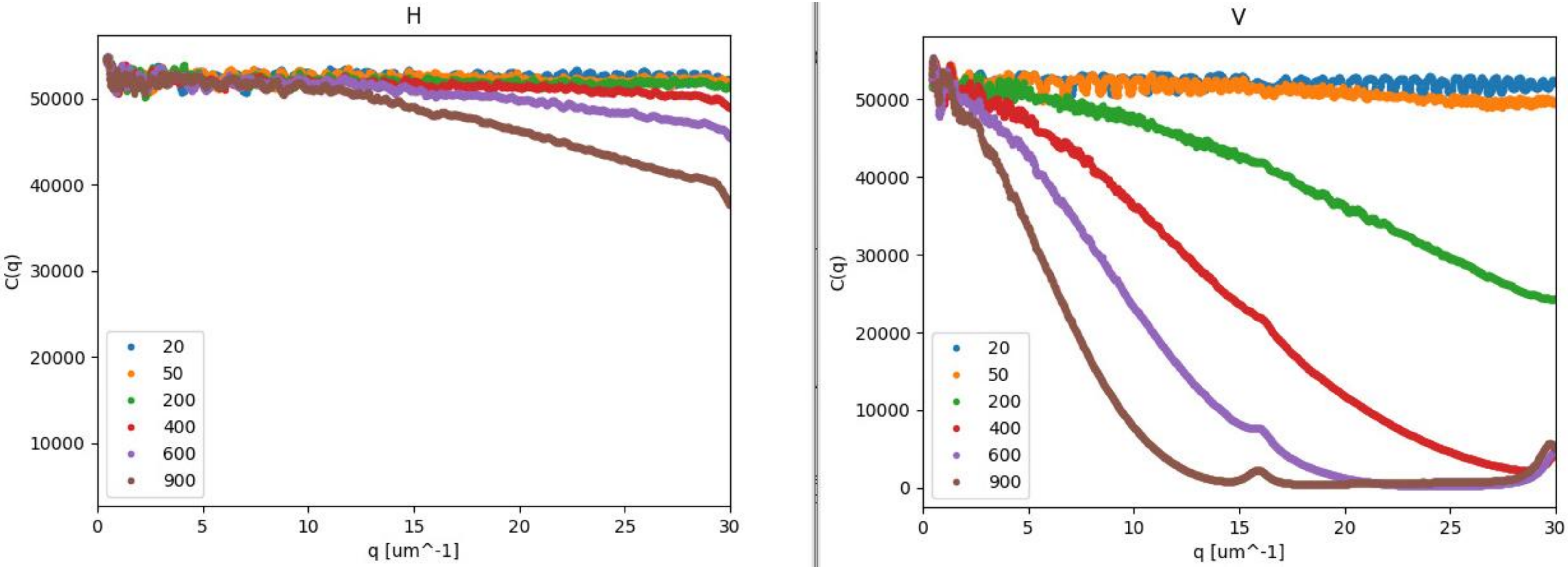


SIMULATION B

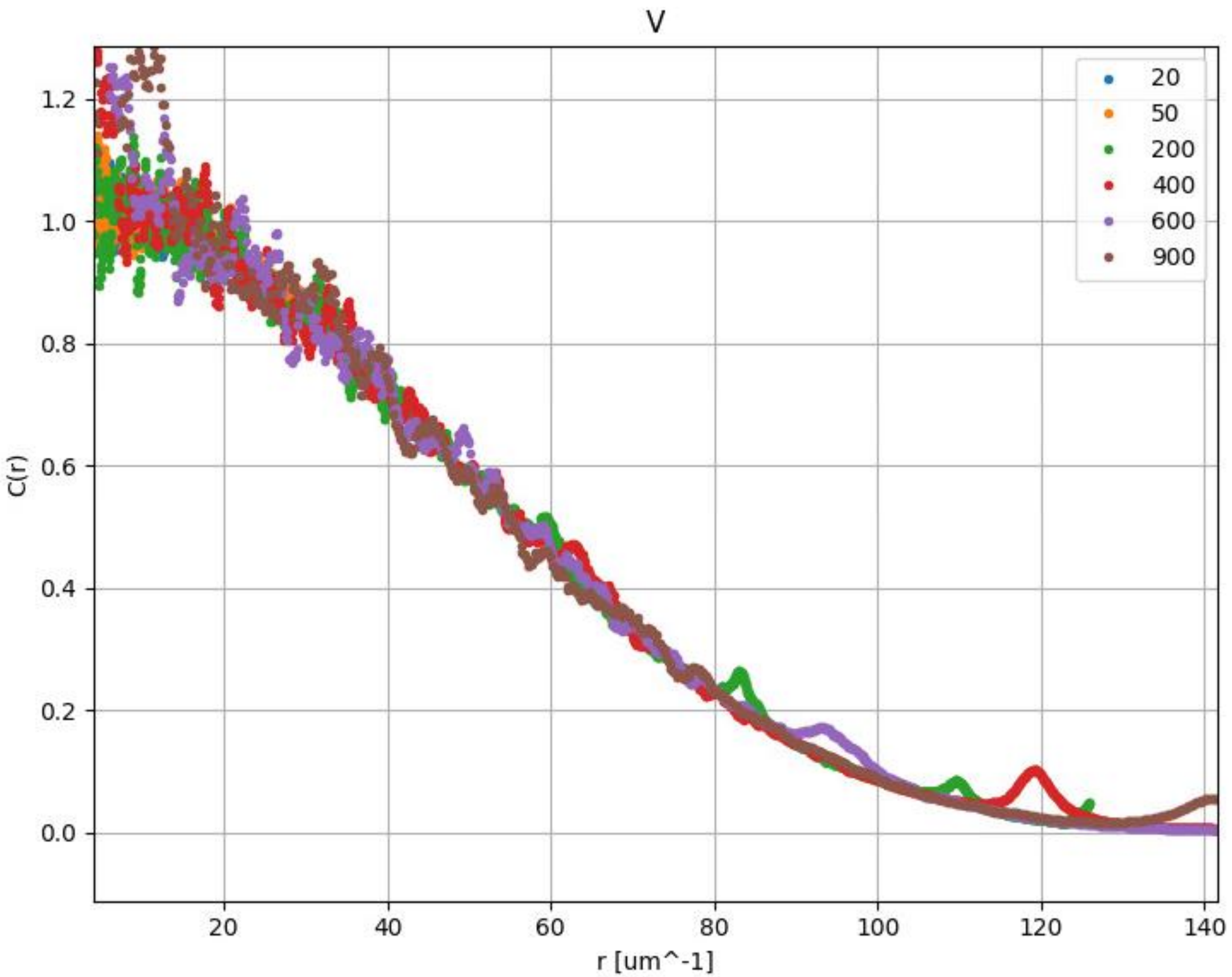




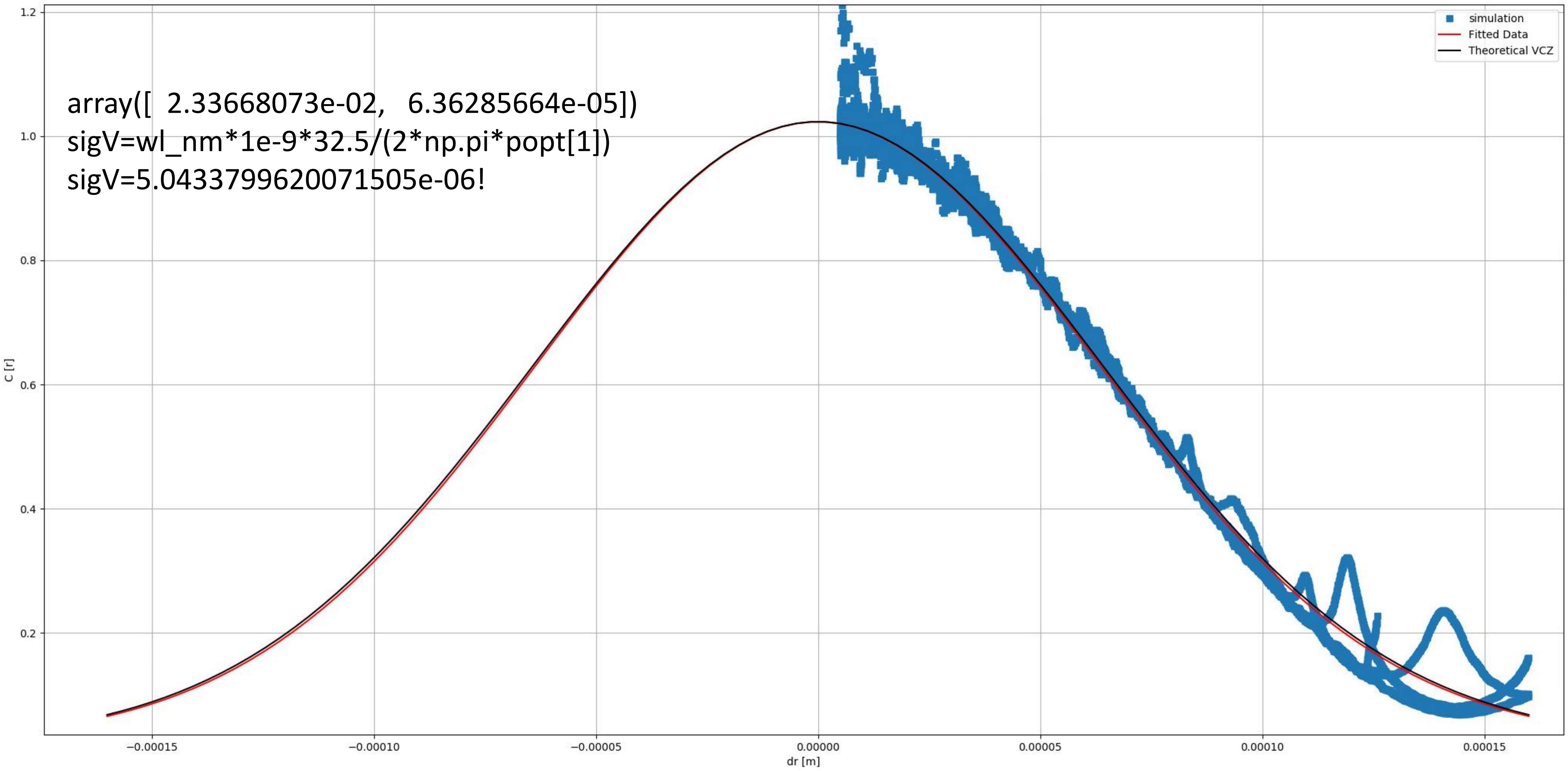
SIMULATION B



SIMULATION B



SIMULATION B



array([2.33668073e-02, 6.36285664e-05])
sigV=wl_nm*1e-9*32.5/(2*np.pi*popt[1])
sigV=5.0433799620071505e-06!

Calibration

$$C(q) = [T(q)*S(q)*c(q)]_{BEAM} \; / \; [T(q)*S(q)]_{refParticle}$$

Is it really 1, at which distance?